HISTORY OF ACQUISITION IN THE DEPARTMENT OF DEFENSE

Volume I

REARMING FOR THE COLD WAR 1945-1960

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Volume I

Foreword

Throughout the second half of the twentieth century, the introduction of new technologies led to remarkable advances in aircraft, missiles, ships, satellites, land vehicles, electronic equipment, and many other weapons and supporting systems employed by the Army, Navy, Air Force, and Marine Corps. At the same time, however, the projects undertaken to develop and produce these systems frequently resulted in large cost overruns and schedule slippages, disrupting budgets and schedules in the Defense Department and in Congress.

The term "defense acquisition" has evolved during the past five decades from the terms "procurement," "research and development," and "production." During the same period, the management of defense acquisition has slowly improved, but not without painful periods of recreating and re-experiencing acquisition management problems of the past. It is my belief that the painful periods have resulted to a significant degree from the absence of a comprehensive history of defense acquisition or even a formal record of lessons learned.

In the late summer of 2001, the U.S. Army Center of Military History invited me to deliver the keynote address at a symposium to mark the beginning of a multivolume research and writing project to produce a comprehensive history of defense acquisition covering the period 1945 to 2000. The project was endorsed and sponsored by the Under Secretary of Defense for Acquisition, Technology, and Logistics, Dr. Jacques Gansler. The Chief Historian of the Office of the Secretary of Defense headed a Joint Oversight Board that designated the U.S. Army Center of Military History as the project's executive agent. I was pleased to accept the invitation to be part of such a worthwhile effort.

In his letter authorizing the study, Under Secretary Gansler pointed out that "during the more than fifty years since the National Security Act of 1947, the Department of Defense acquisition function has experienced great change and received extraordinarily high public visibility and congressional attention. We are missing, however, a comprehensive record of Defense acquisition accomplishments and failures from which we may have an opportunity to learn."

The Defense Acquisition History Project objective was to provide a comprehensive history that describes and analyzes the formulation of acquisition policies, the development of acquisition organizations, and the evolution of the acquisition process. This basic history could then be used as a reference for future acquisition decision makers, project managers, and educators describing how the complex problems associated with defense acquisition, including both its successes and failures, were dealt with in the past.

The three-day Acquisition History Symposium was scheduled for September 10, 11, and 12, 2001, in McLean, Virginia, near the Pentagon and Washington, D.C. On September 10th the keynote address and opening-day meetings occurred as scheduled, but the tragedy in New York City, Pennsylvania, and at the Pentagon on the second day, 9/11, brought the symposium to an abrupt end.

In the months following the symposium, a team of respected historians under the direction of the U.S. Army Center of Military History's Chief Historian, initially Dr. Jeffrey J. Clarke and later Dr. Richard W. Stewart, began to conduct extensive research and writing for what would become the multivolume study, *History of Acquisition in the Department of Defense*. The project continues today under the management of the Historical Office of the Office of the Secretary of Defense. I had the honor of serving as senior acquisition advisor to the project.

Elliott Converse, the team leader of the acquisition historians, is a retired Air Force colonel with a doctorate in history from Princeton University. His Air Force career included assignments as an intelligence officer with the 8th Tactical Fighter Wing during the Vietnam War, as a faculty member at the Air Force Academy and the Air War College, as a strategic planner with the Joint Chiefs of Staff, and as commander of the Air Force Historical Research Agency. He is the author of several books on military history and was chosen to prepare the first volume of the series, dealing with defense acquisition from 1945 to 1960. It did not take long for those of us associated with the project to be impressed with the masterful skill, care, and dedication Dr. Converse brought to his research and writing for what was to be a volume that set high standards for the project.

As work on the Defense Acquisition History Project advanced, six topics or themes were selected to be addressed in varying degrees throughout the volumes. The topics include:

- The Evolution of Acquisition Policies, Organizations, and Processes
- The Political Context of Acquisition
- The Relationship among Technology and Acquisition Policies, Organizations, and Practices
- The Origin and Outcomes of Acquisition Reform
- The Role of the Private Sector in Defense Acquisition
- The Development of the Defense Acquisition Workforce

The construction of each acquisition history volume is more narrative than analytical, but includes ample interpretations and a number of conclusions. The volumes are based on extensive primary source materials from the Office of the Secretary of Defense and the military services along with a number of secondary accounts.

The Defense Acquisition History Project caps fifty stimulating and enjoyable years of my own research and teaching various aspects of defense acquisition, as well as four years as a naval officer, two years as project manager for the design of the Polaris Program cost planning and control system, two years as deputy assistant secretary of the Air Force, two years as assistant secretary of the Army, and two decades as a professor at the Harvard Business School. It has been an honor and a pleasure for me to work with the Army Center of Military History, the Office of the Secretary of Defense, and the historians participating in this project.

J. Ronald Fox
Jaime and Josefina Chua Tiampo
Professor of Business Administration, Emeritus
Harvard Business School

Preface

This volume is a history of the acquisition of major weapon systems by the United States armed forces from 1945 to 1960, the decade and a half that spanned the Truman and Eisenhower administrations following World War II. These instruments of warfare—aircraft, armored vehicles, artillery, guided missiles, naval vessels, and supporting electronic systems—when combined with nuclear warheads, gave the postwar American military unprecedented deterrent and striking power.[1] They were also enormously expensive. A Brookings Institution study estimated that from the end of World War II through the mid-1990s the United States spent over $5 trillion (including the cost of the wartime atomic bomb project) on the development, production, and deployment of nuclear weapons, and on the systems for delivering and defending against them. Twenty percent of that sum was expended between 1945 and 1960.[2]

Although there is a large body of published literature on specific aspects of weapons acquisition, primarily studies of individual systems, no in-depth analysis has yet appeared that combines the histories of the Office of the Secretary of Defense (OSD) and the military services into one account. Such a study is badly needed. World War II was a watershed for acquisition. The postwar defense environment was dramatically different from that existing before the war. So too were the policies, organizations, and processes that governed the acquisition of new weapons. Many of the changes that shaped the nature and course of acquisition through the end of the century were instituted between 1945 and 1960. Additionally, many of the problems that have repeatedly challenged defense policymakers and acquisition professionals since World War II first surfaced during those years. History does not repeat itself exactly; but by revealing long-term trends and the reasons for past choices, it can help illuminate the path forward for those who must grapple with the complex issues surrounding the development, production, and deployment of major weapon systems.

The volume is organized chronologically, with individual chapters addressing the roles of OSD, the Army, Navy, and Air Force in two distinct periods. The first, roughly coinciding with President Truman's tenure, covers the years from the end of World War II through the end of the Korean War in

1953. The second spans the two terms of the Eisenhower presidency from 1953 through early 1961. The year 1953 marked a natural breakpoint between the two periods. The Korean War had ended. President Eisenhower and his defense team began implementing the "New Look," a policy and strategy based on nuclear weapons, which they believed would provide security and make it possible to reduce military spending. The New Look's stress on nuclear weapons, along with the deployment of the first operational guided missiles and the rapid advances subsequently made in nuclear and missile technology, profoundly influenced acquisition in the services throughout the 1950s and the remainder of the century.

Much more attention is paid in this volume—more than double the number of chapters—to the services' roles in acquisition than to OSD's. Comparable studies of later periods will likely reverse that emphasis. Before 1947, the Army and Navy possessed nearly complete independence in acquisition, subject only to the president and Congress. The National Security Act of 1947 created a new defense structure that interposed a civilian secretary of defense between the military departments and the president. In theory, the act gave the secretary of defense authority over acquisition, but, in practice, the services retained much of their autonomy in this arena through the end of the 1950s. Only slowly did OSD seek to exercise more power over acquisition, mostly through its control of the budget. While intervention by OSD could be dramatic (Secretary of Defense Louis A. Johnson's summary cancellation of the Navy's flush-deck carrier *United States* in 1949 is perhaps the best-known example), other than involvement in the budget cycle, it played no formal, systematic role in the acquisition process.

As used in this study, the term "acquisition" encompasses the activities by which the United States obtains weapons and other equipment. The process begins with the identification of a requirement for a system, passes through its research and development, test and evaluation, purchasing and production, to its fielding with operational units and its subsequent modification, sustainment, and eventual disposition.[3] Oddly enough the word "acquisition" was rarely used to describe this process for most of the period from 1945 to 1960.[4]

During those years, the word usually employed was "logistics."[5] Not until the late 1950s and early 1960s did "acquisition" become part of the vocabulary of weapons procurement. As time passed, the term assumed more and more of the umbrella meaning that had originally been associated with the term "logistics." Ironically, by the end of the twentieth century, logistics had taken on a much narrower meaning—generally referring to the support of weapons already fielded. In this volume, "acquisition" will be used in the overarching sense that it currently possesses.

Evolution of the Term "Acquisition"

The first important use of the term "acquisition" in its current meaning was likely in a Harvard Business School study of U.S. weapons procurement that was initiated in late 1957 following the national alarm generated by the two Soviet earth-orbiting satellites, the Sputniks. An internal project paper, dated 11 July 1958 and entitled "Research Project on Business and Government Relationships in Weapons Acquisition," stated that the study's purpose was to examine those relationships "in the processes by which new weapons are conceived, developed and procured for use by the armed forces." According to Dr. Frederic M. Scherer, one of the study group's members, the term was coined for the project by its director, Dr. Paul W. Cherington, and was subsequently adopted by the military. The first significant official use of the term "acquisition" was probably in the Air Force's 375 series of regulations that codified many of the procedures and techniques developed in managing its ballistic missile programs (see chap. 9 in this volume). The first of these, AFR 375–1, published in August 1960, divided a weapon system's life cycle into three main phases: "conceptual," "acquisition," and "operational." The acquisition phase encompassed development and production. In 1962, the publication of Merton J. Peck's and Frederic Scherer's landmark work, *The Weapons Acquisition Process: An Economic Analysis,* introduced the term to an audience outside the Air Force and the Defense Department. Early in 1964, the Department of Defense adopted the Air Force terminology. DoD Directive 3200.9 (Initiation of Engineering and Operational Systems Development) included three phases in the process for acquiring new systems: "Concept Formulation," "Contract Definition," and "Acquisition." The latter phase included development and production.[1]

This history focuses on certain aspects of acquisition, primarily research and development, test and evaluation, contracting, and production. The post-production phases of acquisition—deployment and logistic support—are normally covered in this study only when they reflected the other phases. In contrast, requirements determination—at the front end of the acquisition process—receives considerable attention. Until the 1980s or later, defense acquisition professionals, while recognizing the importance that the formulation of a requirement for a system had upon its subsequent development, did not normally consider this function as belonging to their sphere of activity.[6] Traditionally, it has been seen as the exclusive domain of the uniformed military and has been carried out at the highest levels of the services, usually outside of specialized acquisition organizational structures. The history of acquisition in the period covered by this volume suggests that separating the identification of requirements from the subsequent phases of acquisition was a detriment to both.

Between 1945 and 1960, activities associated with acquisition, except requirements and deployment, were usually represented by terms that corresponded to two major categories of military appropriations—research and development (R&D) and procurement.[7] Not only did these two terms encompass most acquisition activities, but they also generally identified the opposing forces in an internal bureaucratic conflict, common to all the services, for organizational status, influence, and funding in the materiel arena that marked the late 1940s and the 1950s. Nonetheless, for much of this period, the services lacked a common definition of either research and development or procurement; each developed its own definitions of those terms.[8] Even within a service, acceptable definitions were hard to arrive at because acquisition professionals, in a reflection of the ongoing intraservice bureaucratic contests, could not agree when development ended and procurement (production) began.

Despite these difficulties, it is essential to present some general definitions at the outset. In 1949, the Department of Defense's Research and Development Board, comprised of representatives from each service, included the definition of research and development that had appeared in the Atomic Energy Act of 1946 in a listing of budgetary and fiscal terms that it forwarded to the secretary of defense: "The term 'research and development' means theoretical analysis, exploration, and experimentation, and the extension of investigative findings and theories of scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials, and processes."[9] The term procurement was less controversial. During this period, it generally meant the purchase (contracting), quantity production, and supply of materiel.

To help make sense of the numerous and complex functions involved in acquisition, this volume organizes discussion of them around several broad topics and themes. These are the evolution of acquisition organizations and processes; the interservice and intraservice political context of acquisition; the relationship between advancing technology and acquisition policies, organizations, and practices; the role of the private sector—the defense industry—in new weapons development; the origins and growth of a specialized acquisition workforce; and acquisition reform.

In surveying the history of acquisition between 1945 and 1960, this study discusses or refers in passing to many of the hundreds of weapon system programs initiated by the services in that period, but it is not a weapons encyclopedia. Instead, it investigates a few major programs in depth in the belief that such detailed examination best reveals the evolution of acquisition policies, organizations, and processes, and the various forces influencing weapons programs. Thus, for example, the chapter on the Navy between 1945 and 1953 focuses on three systems that together gave the Navy a nuclear weapons delivery capability: smaller and lightweight nuclear warheads, the AJ–1 heavy attack aircraft, and larger aircraft carriers represented by the cancelled *United States*. It also closely examines Navy and Marine Corps acquisition of the LVTP–5 and LVTH–6 amphibious tracked landing vehicles. Similarly, the chapter on the Air Force following the Korean War provides a detailed look at the B–58 supersonic bomber and the Atlas, Titan, and Thor ballistic missile programs to illustrate that service's application of the weapon system approach to acquisition.

Much has been published on specific aspects of acquisition in the late 1940s and the 1950s; most of these studies cover individual weapon systems, but some are general works. This volume has drawn heavily on these materials. In addition to this secondary literature, it has extensively used the vast quantity of documentary sources—in the millions of pages— bearing on this subject that are housed in archives located principally in Washington, D.C., but also in other repositories around the country. The huge amount of this documentation, along with security restrictions still limiting access to a significant percentage of it, are principal reasons that much of the history of acquisition, even for the decade and a half following World War II, is yet to be written.

Endnotes

1. In the late 1980s, Congress began to define a "major system" by assigning dollar thresholds for research, development, test, and evaluation (RDT&E), and for procurement (production) costs. In 2009, the thresholds were systems that cost more than $300 million for RDT&E or more than $1.8 billion for procurement. See sec. 2430 (Major defense acquisition program defined), chap. 144, pt. IV, subtitle A, title 10, U.S. Code.
2. Stephen L. Schwartz, ed., *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons since 1940*, 3-4, 8. The $5 trillion figure is expressed in constant 1996 dollars. All other dollar amounts in this volume in the acquisition history series are presented as "then-year" dollars.
3. In the glossary of terms published by the Defense Acquisition University (established in 1992), acquisition is defined as the "conceptualization, initiation, design, development, test, contracting, production, deployment, logistics support, modification, and disposal of weapons and other systems, supplies or services (including construction) to satisfy DoD [Department of Defense] needs, intended for use in or in support of military missions." See Learning Capabilities Integration Center, Center for Acquisition and Program Management, Defense Acquisition University, *Glossary of Defense Acquisition Acronyms and Terms*, 13th ed., B-1.
4. A passage in the secretary of the Navy's report for fiscal year 1947 constitutes one of the few examples discovered in the course of the research for this volume of the term "acquisition" having been used as it is today: "The fiscal year 1947 was marked by Navy acquisition for test, of the first all-jet aircraft intended for operations at sea from aircraft carriers." See Department of the Navy, *Annual Report of the Secretary of the Navy for Fiscal Year 1947*, 18.
5. For the evolution of the meaning of the term "logistics" in military history through the mid-1950s, see the introductory essay, "Logistics—The Word and the Thing," in Richard M. Leighton and Robert W. Coakley, *Global Logistics and Strategy, 1940–1943*, 3-17. See also, Steven L. Rearden, *The Formative Years, 1947–1950*, 90.
6. Jacques Gansler, under secretary of defense for acquisition, technology, and logistics, 1997–2001, is one of those who view requirements determination as an integral part of acquisition: "The overall process of *specifying the requirements for a weapon system* through its design, development, production and subsequent deployment and support is known as the system acquisition process; . . ." [italics added]. See Jacques Gansler, "Technology Acquisition

and Development," *International Military and Defense Encyclopedia*, 2686. In the late 1940s and early 1950s, John Perry Miller, one of the leading analysts of military materiel practices in that era, expressed a similar perspective. In his *Pricing of Military Procurements*, (p. 2), Miller wrote: "Military logistics involves three main functions: *the determination of requirements*, procurement of material, and distribution of this material to places where it may be most effectively used. Clearly, these three components are interdependent, and there are compelling reasons for urging that they should be more closely coordinated than they have been in the past." [italics added].
7. At the end of the 1950s, each military department's research and development appropriation began to include funds for test and evaluation, and the category was redesignated RDT&E.
8. Memo, Lee Anna Embrey for Dr. Walker [Eric A. Walker, executive secretary, Research and Development Board], 10 July 1950, sub: Research and Development Definitions, 2-4, folder 2, box 592, entry 341 (Research and Development Board), Record Group [hereafter RG] 330 (Records of the Office of the Secretary of Defense), National Archives at College Park, College Park, Md. [hereafter Archives II]. Unless indicated otherwise, citations to materials from RG 330 are to those deposited at Archives II. In early 1958, in response to a request from the chairman of the House Committee on Government Operations, the deputy secretary of defense provided definitions of "basic research," "applied research," and "development." In their responses to the same request, the three services referred to the definitions that had been submitted by the deputy secretary of defense. See app. 2 (Staff Report on Budget Evaluation, Department of Defense and the Departments of the Army, Navy, and Air Force for the Fiscal Years 1950 to 1958 as of March 31, 1958) in House of Representatives, 32d Report of the Committee on Government Operations, *Research and Development (Office of the Secretary of Defense)*, 85th Cong., 2d sess., 1958, H. Rpt. 2552, 79, 82, 117, 151, 175-76, 199.
9. Memo, Embrey for Walker, 10 July 1950, 5.

I. Sources: Copy of 11 July 1958 project paper provided to the author by Dr. Frederic M. Scherer; and G. K. Smith and E. T. Friedman, *An Analysis of Weapon System Acquisition Intervals, Past and Present*, 3.

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CHAPTER I

World War II: A Watershed

World War II was one of history's watersheds—an event of such great consequence that it destroyed or dramatically altered political, economic, and social structures and patterns in place when the conflict began, setting most of the earth's nations and peoples on new courses. Worldwide, for example, the war hastened the end of Western colonialism. At its founding in 1945, the United Nations comprised 51 nations. By 1961, membership had more than doubled to 104 nations; two-thirds of the new arrivals were former colonies of the European states.[1] In the United States, the war was the catalyst for far-reaching economic and social changes, including the industrialization of the South and the West and equality for women and blacks.[2] But most immediate and significant was that it revolutionized the nation's role in international affairs. Following the war, the United States turned away from its traditional isolationism and took up leadership of the world's democracies. To fulfill this responsibility and to preserve the nation's security, American leaders felt compelled to maintain powerful military forces. This conviction, coupled with the decision to anchor military strength in advanced weapons technologies, meant that the acquisition of materiel, a function that had also been transformed by the war, would assume unprecedented importance even in peacetime.

Until 1945, except in wars, the United States had followed an "isolationist" foreign policy. This did not mean that the nation cut itself off from the world; Americans had traded continuously with other nations since colonial times. Rather, the United States shied away from making formal, peacetime political and military commitments with other nations, particularly in Europe. Thus, after World War I, the Senate refused to ratify the Treaty of Versailles, strongly supported by President Woodrow Wilson, that would have made the United States a member of the League of Nations.[3]

World War II convinced Americans that the United States could not return to isolationism when the shooting stopped. For one thing, many believed that the failure to ally with the other Western democracies had encouraged German, Italian, and Japanese aggression during the 1930s; in the future, aggressors must be dealt with promptly and decisively. For another, weapons introduced during the war—long-range aircraft, guided missiles, and the atomic bomb—clearly indicated that the United States could no longer rely on the oceans for protection (an accident of geography that had made isolationism tenable in the first place). Consequently, in July 1945, with only two dissenting votes, the Senate ratified the United Nations Charter, thereby signaling a dramatic change of direction in American foreign policy.

George F. Kennan, director of the State Department's Policy Planning Staff, 1947–1949, and leading advocate of containing Soviet expansion.

George F. Kennan (1904–2005)

George Kennan, U.S. Minister-Counselor in Moscow from 1944 to 1946 and director of the State Department's Policy Planning Staff beginning in 1947, was the intellectual architect of the containment strategy. He publicly (but anonymously) expressed the concept in a famous article signed "X" in the July 1947 issue of the influential journal *Foreign Affairs*, writing in part that "the main element of any United States policy toward the Soviet Union must be that of a long-term, patient but firm and vigilant containment of Russian expansive tendencies." Years later, Kennan maintained that he had not intended for the U.S. response to Soviet expansionism to be largely military, but primarily, political, economic, and diplomatic. For more about Kennan and the evolution of the containment policy, see John Lewis Gaddis, *Strategies of Containment: A Critical Appraisal of American National Security Policy during the Cold War.*

Membership in a world-peacekeeping organization was part of President Franklin D. Roosevelt's vision of the nation's postwar role. He also believed the United States must be a leader in the world community in peace as it had been in war. Indeed, according to his "Four Policemen" concept, the United States, Great Britain, the Soviet Union, and China would keep the peace in various "zones" until the new international organization was in full operation. Underlying the Four Policemen scheme and the hopes for an effective assembly of nations was the assumption that the "Grand Alliance" of the four major powers would hold together after the war.[4] It did not. Always primarily a union born of necessity, the alliance quickly dissolved, unable to overcome antithetical ideologies and conflicting national interests.[5]

The year and a half following Japan's surrender in September 1945 witnessed a sharp deterioration in relations between the Western allies and their former partner, the Soviet Union. Almost immediately, disagreements arose over reparations; the future of Germany, then divided into four occupation zones; and the fate of the countries of Eastern Europe, which expected self-determination through free elections in accordance with agreements reached during the war, but were occupied by the Red Army and considered by the Soviets to be part of their security sphere.

Soon confrontation between the Western allies and the Soviet Union spread from Central and Eastern Europe to the Near East and Southeastern Europe. Crisis followed crisis in quick succession. Strong U.S. opposition to the continued presence of Soviet troops in northern Iran darkened the winter of 1945–1946. Then in August, the Soviet Union demanded that Turkey's control of the strategic Dardanelles, guaranteed by the Montreux Convention of 1936, be modified in the Soviets' favor. The United States immediately objected, and President Harry S. Truman approved plans to send a Navy task force to the eastern Mediterranean. When the Yugoslavs shot down two American transport aircraft over their territory soon after the president's response to Soviet pressure on Turkey, war seemed likely to some high-level American officials. Although the tension produced by the Turkish crisis subsided, in early 1947 alarm bells rang again in Washington at reports the Soviets were behind the collapse of order in Greece. This news, combined with the announcement of Great Britain's decision to end its aid program to the Greek government, resulted in swift American action.[6] On 12 March 1947, President Truman asked Congress to approve $400 million in aid for Greece and Turkey, declaring that "it must be the policy of the United States to support free peoples who are resisting attempted subjugation by armed minorities or by outside pressure."[7] In proclaiming what came to be known as the Truman Doctrine, writes historian Daniel Yergin, the president "committed the United States to a global struggle with the Soviets."[8]

In the spring of 1947, the United States was even more concerned about conditions in Western Europe. The war had devastated nearly every European country, and the winter of 1946–1947 had been especially difficult, leading former British Prime Minister Winston Churchill to exclaim: "What is Europe now? A rubble heap, a charnel house, a breeding ground of pestilence and hate."[9] Many feared that economic and social chaos would lead to political collapse and Communist takeovers. In June 1947, Secretary of State George C. Marshall, speaking at Harvard University, offered a program of economic assistance to all of Europe, including the Soviet Union. Although the Soviets rejected the proposal both for themselves and for the nations of Eastern Europe (confined behind what Churchill called an "iron curtain"), the Western Europeans were enthusiastic. The Truman Doctrine and the Marshall Plan were both aimed at forestalling Communist expansion. Taken together they constituted the Truman administration's articulation of containment. This national security strategy, initially advanced by senior American diplomat George F. Kennan, was reaffirmed early in the administration of President Dwight D. Eisenhower and continued to be a bedrock principle of U.S. policy through the breakup of the Soviet empire in 1989.[10]

Between 1947 and 1950, it became clear that the United States and the Soviet Union were engaged in a cold war that threatened to catch fire at any moment. Containment appeared not to be working. In February 1948, the Soviets engineered a coup by Communists in Czechoslovakia. In June, they cut off U.S., British, and French access to the Western zones of occupation in Berlin. The blockade was broken in less than a year through an airlift that avoided direct conflict between Western and Soviet ground forces, but the USSR's action had risked open war. In August 1949, the Soviets exploded their first atomic bomb, ending the U.S. nuclear monopoly and heightening the fears of many Americans that the weapon might be used against them. In the fall, Mao Zedong's Communists, thought to be controlled from Moscow, seized power in China, forcing the U.S. wartime ally, Chiang Kai-shek and his Nationalist Party supporters, to flee the mainland to the island of Taiwan (then called Formosa).

The U.S. response to these developments focused increasingly on the military dimension of national power. In April 1949, the United States, together with Great Britain, Canada, and nine nations in Western Europe, formed the North Atlantic Treaty Organization (NATO). Each of the signatories agreed that an attack upon one would be considered an attack upon all. Although the United States had entered into a collective security arrangement with its Western Hemisphere neighbors in the Treaty of Rio de Janeiro (Rio Pact) in 1947, membership in NATO established a precedent: For the first time in its history, the nation had concluded a formal military alliance with Europe in peacetime. In the 1950s, the United States formed or encouraged the formation of other similar regional security alliances.[11]

Soon after detonation of the Soviet atomic bomb, the United States sought to buttress its military power by going ahead with a project to develop the much more powerful hydrogen bomb. This decision, taken by President Truman in January 1950, ratcheted up a race for nuclear arms under way since 1945. At the same time, the president directed a thorough review of national security policy. Submitted in April, the resulting report, National Security Council paper

68, or NSC 68 (United States Objectives and Programs for National Security), revalidated the containment policy and also made the case for the massive increases in military spending thought necessary to carry it out. Truman, worried about the high cost of such a program and its possible impact on the economy, did not immediately approve the recommendations.[12] The North Korean invasion of South Korea in June 1950 and the subsequent Chinese Communist intervention that fall, however, provided justification for the large-scale rearmament urged in NSC 68.

From the experience of World War II, American leaders concluded that the United States must coordinate the application of all elements of its national power—political, economic, and military—to achieve its international and security objectives. The National Security Act of 1947 established an organizational structure designed to bring this synchronization about.[13] At the highest level and chaired by the president, the National Security Council formulated policy.[14] Another new body, the National Security Resources Board, focused on planning for industrial and civilian manpower mobilization. To collect, assess, and disseminate intelligence bearing on national security, the act chartered the Central Intelligence Agency, a descendant of World War II's famous Office of Strategic Services.

Reorganization of the armed forces, however, was the central and most controversial feature of the National Security Act. The legislation created the National Military Establishment (renamed the Department of Defense in 1949) headed by a civilian secretary of defense charged with coordinating the activities of the military services, organized into three departments—Army, Navy, and Air Force—each headed by a civilian secretary. The act also formalized the Joint Chiefs of Staff arrangement that had grown up during World War II. The uniformed heads of the three services (and eventually a fourth member, a chairman) served as the "principal military advisors to the President and the Secretary of Defense." Additionally, the National Security Act set up two interdepartmental coordinating agencies for materiel that operated under the secretary of defense, the Research and Development Board and the Munitions Board.

When the Truman administration announced the containment policy in the spring of 1947, the role that U.S. military forces would play in implementing it was uncertain.[15] At that time, the armed forces were in the midst of a demobilization that seemed to repeat the pattern following previous wars. In Fiscal Year (FY) 1945, nearly $83 billion had been spent on defense (of total federal outlays of about $93 billion) and more than 12 million Americans were in uniform. In contrast, by the time the Korean War started in June 1950, military spending had fallen precipitously, averaging about $12 billion annually in FYs 1948–1950 (of total federal outlays averaging just over $37 billion during those years) and military strength had plummeted to 1,459,000 personnel.[16] Most historians agree that this force was not ready to fight a conventional war in Korea. Yet the dramatic differences in defense spending and in force levels between the end of World War II and the onset of the Korean War, or even the lack of preparedness when the Cold War turned hot, should not obscure the fact that a fundamental change had taken place with respect to the nation's historic aversion to a large, peacetime military establishment. The $12 billion average annual outlays for FYs 1948–1950 were almost 8 times those for FY 1940 ($1.5 billion) when the United States began to rearm in response to the outbreak of war in Europe, and more than 16 times the annual average from 1922 to 1939 (approximately $750 million). Similarly, the nearly 1.5 million personnel in uniform in June 1950 were more than 3 times the number on active duty in 1940, and 6 times the annual average between 1922 and 1939 (about 250,000). Thus, after World War II, the leaders of both major political parties and the American people, generally, abandoned tradition and agreed that the United States must maintain substantial military forces in peacetime.[17]

War in Korea initiated the military buildup that the authors of NSC 68 had recommended. The purpose of the rearmament program, however, was not only to meet the needs of that conflict but also to strengthen "free-world" capabilities in response to the belief that the threat from the Soviet Union and communism had increased dramatically, particularly in Western Europe. Defense spending climbed rapidly and sharply. Outlays for FY 1951 were $23.5 billion—approaching twice the $13.7 billon for FY 1950. Expenditures skyrocketed to $46 billion in FY 1952, and then to $52.8 billion in FY 1953, the last year of the war.[18] With respect to force structure, the Army doubled in size from 10 to 20 divisions; the number of the Navy's major combatant vessels grew from 238 to 409; and the total of Air Force wings expanded from 48 to 106.[19] When the shooting stopped in Korea in July 1953, the active armed forces numbered more than 3.5 million personnel.[20]

Following the Korean War, the military establishment contracted. But in relative terms, the reductions were modest compared to those after previous wars. In FY 1955 (the first year that did not reflect Korean War costs), Defense Department spending dropped to less than $43 billion. In FY 1957, it began to rise steadily through FY 1961, the last year of the Eisenhower administration, to more than $49.5 billion.[21] During those same years, annual uniformed strength averaged over 2.7 million.[22] The high levels of military spending during the 1950s reflected the triumph of the conviction, first implemented after World War II and reinforced by the Cold War, that the United States must maintain a strong peacetime military establishment to provide security and deter war.

Deterrence of war, like containment and collective security, a fundamental precept of U.S. policy throughout the Cold War, was to be achieved by maintaining such powerful military forces and by demonstrating such firm determination to use them that no nation would be tempted to resort to armed aggression. Although the concept of deterrence had been a key element in the postwar planning done by the military before the end of World War II, it did not become official U.S. policy until late 1948 when President Truman approved National Security Council paper 20/4 (U.S. Objectives with Respect to the U.S.S.R.). The first postwar statement of basic national policy, the paper required "a level of military readiness which can be maintained as long as necessary as a deterrent to Soviet aggression."[23] That deterrence failed in Korea did not indicate to American leaders that the policy was unsound, only that the forces intended to buttress it were inadequate.


James V. Forrestal, secretary of defense, 1947–1949.

To enforce deterrence, the Truman administration increasingly and the Eisenhower administration almost completely depended on strategic air power, primarily the nuclear-armed, long-range aircraft of the Air Force's Strategic Air Command. James V. Forrestal, who became the first secretary of defense in 1947, advocated a "balanced force" concept with ground, naval, and air forces all contributing to deterrence and overall national security.[24] But with the high cost of conventional forces, the economy-minded Truman administration and Forrestal himself saw little alternative to strategic air power employing nuclear weapons as the principal means of forestalling aggression. Faced with the perceived need to maintain much higher levels of military spending, but equally concerned about the impact of such expenditures on the economy, the Eisenhower administration relied to an even greater extent on nuclear weapons. Its "New Look" policy aimed at getting the biggest "bang for the buck" and deterring war at any level of conflict by confronting potential aggressors with the threat of nuclear "massive retaliation."

Among the military services, the Air Force became the main beneficiary of the decision to seek security through strategic nuclear deterrence. By the late 1940s, in the view of many, it had supplanted the Navy as the nation's "first line of defense." The new service's relative importance was reflected in its ever-increasing share of the Defense Department's budget. In FY 1949, the Air Force drew only 22 percent of the budget, the Navy 34 percent, and the Army 44 percent. The next year, with the Cold War clearly intensifying, the balance shifted: the Air Force's budget slice climbed to 36 percent, with the Navy and the Army splitting the remainder almost equally. By the end of the Korean War, the Air Force achieved budgetary preeminence, receiving almost 44 percent of the FY 1953 appropriation. From then on, except for FY 1954 (the last year that reflected spending for the Korean War), the Air

Force obtained the same or greater percentage annually through FY 1961, the Eisenhower administration's final budget.[25]

The principal elements of the U.S. strategic deterrent—nuclear weapons; long-range, jet-powered bombers; and, by 1961, intercontinental ballistic missiles—were the most advanced military technologies of the time. The development and evolution of these and other systems after World War II resulted from a conscious decision by American leaders to seek security through technological superiority. They believed that the superior quality of U.S. weapons would trump the greater number of weapons or larger armies that likely opponents were expected to deploy. For example, in mid-1949, Karl T. Compton, chairman of the Defense Department's Research and Development Board and former president of the Massachusetts Institute of Technology (MIT), wrote that the United States sought "to maintain a requisite military power by technological superiority . . . rather than by the maintenance of a huge professional armed force."[26] Five years later, President Eisenhower reaffirmed the principle in a letter to Secretary of Defense Charles E. Wilson: "[W]e should base our security upon military formations which make maximum use of science and technology in order to minimize numbers in men."[27]

It is ironic, as historian Alex Roland has noted, that U.S. leaders concluded after World War II that the next war would be won by the best weapons.[28] To a great extent, the Allies prevailed over the Axis powers because instead of fielding many new weapons, they produced weapons in massive quantities (the war, reportedly said Dwight Eisenhower, was won in Detroit).[29] Although important advanced systems such as radar, the proximity fuze, the bazooka, the B–29 long-range bomber, and the atomic bomb were introduced during the war, for the most part the United States fought with the weapons and weapon designs that were on hand when it entered the conflict. Except for the atomic bomb and a few other new technologies like radar, research and development was directed primarily at improving existing weapons.[30] Thus, for example, in 1945 the aerial gunner on a B–17 bomber fired from inside an electrically driven, plexiglass turret; four years before, on an earlier model of the aircraft, his predecessor had struggled against the slipstream.[31]

The transformation from security through quantity to security through quality was a result of the demonstrated (and projected) capabilities of advanced weapons that appeared toward the end of the war. In 1944, V–2 rockets, the first ballistic missiles, descended on London in minutes, undetected and virtually invulnerable, from launching sites in Germany. At the end of the year, Theodore von Karman, the American rocket pioneer, reported to General H. H. Arnold, commanding officer of the Army Air Forces, that ballistic missiles with intercontinental range were feasible.[32] In August 1945, one atomic bomb carried by a long-range B–29 destroyed an entire city. In October 1946, another B–29 flew over 9,500 miles nonstop and without the benefit of aerial refueling (not available until the late 1940s) from the Hawaiian Islands over the North Pole to Cairo, Egypt.[33] The lessons to be drawn from the destructive power, range, and speed of these weapons were clear: in the future the United States would no longer be safe behind its traditional ocean barriers and would not have the time to mobilize and outproduce an enemy as it had in World War II. It must fight with the weapons available when war started and ensure that they were superior to those of any opponent.

The need to maintain technological superiority solidified and perpetuated the ties between American science and the military established during the war. In previous conflicts, science offered its services to the nation but, with the cessation of hostilities, scientists had returned to their pre-war pursuits. Thus, after World War I, the scientific community had little connection with the War and Navy Departments. Military research and development was largely performed in government-owned arsenals, laboratories, and shipyards staffed by military and civil service personnel. Some of these facilities, such as Army's Springfield Armory in Massachusetts (established 1794), had been in operation since the late eighteenth and early nineteenth centuries. But funding for military research and development was minuscule during the 1920s and 1930s. In FY 1937, the Army and Navy combined spent just over $13 million on R&D. In FY 1940, with war already under way in Europe, the services devoted only slightly over twice that amount—less than one and a half percent of the total $1.8 billion military budget for that year—to research and development.[34] Additionally, each service carried out this work independently, coordinating only informally with the other.

World War II revolutionized the place of science and technology in the U.S. defense posture. Scientists and engineers voluntarily participated in the war effort en masse and enjoyed an unprecedented influence on policy regarding science and technology's application to warfare.[35] In June 1940, President Roosevelt established the National Defense Research Committee to channel additional resources into the military's research and development programs. Among other things, he tasked it to investigate the use of uranium fission in national defense. That work evolved into a project to develop an atomic bomb and was eventually transferred to the Army, under cover of the Manhattan Engineering District (the "Manhattan Project"). In 1941, Roosevelt enlarged science's role by creating the Office of Scientific Research and Development (OSRD), with Vannevar Bush (who had also headed the National Defense Research Committee) as its director.[36] Bush and the Office of Scientific Research and Development exercised enormous power over the nation's wartime research and development activities, including those of the War and Navy Departments. In addition to advising the services and supporting their programs, the OSRD was also authorized to sponsor its own research and development projects, whether requested by the military or not. In all, the National Defense Research Committee and the Office of Scientific Research and Development obligated more than $500 million, almost all of it on weapons projects and the great majority through contracts with relatively few academic institutions and large industrial firms with their own research and development programs.[37]

Vannevar Bush (right), director, Office of Scientific Research and Development, and James B. Conant, president, Harvard University and chairman, National Defense Research Committee, after witnessing the first atomic bomb explosion, Alamogordo, New Mexico, 16 July 1945.
Courtesy, MIT Museum.

The services themselves spent huge amounts of money on research and development during the war. From FY 1940's paltry $26 million, their expenditures reached the wartime high of more than $600 million in 1945.[38] In contrast to the years before the war, the military, pressured by Bush through President Roosevelt, also set up a mechanism for coordinating Army, Navy, and OSRD research programs. In 1942, the Joint Chiefs of Staff formed the Joint Committee on New Weapons and Equipment. Chaired by Bush, it included both civilian and military representatives and reported directly to the Joint Chiefs.[39]

VANNEVAR BUSH (1890–1974)

"The mighty edifice of government science," wrote historian A. Hunter Dupree in 1957, "dominated the scene in the middle of the twentieth century as a Gothic cathedral dominated a thirteenth-century landscape. The work of many hands over many years, it universally inspired admiration, wonder, and fear." Its principal architect was Vannevar Bush—mathematician, electrical engineer, science administrator, and key adviser on science and technology policy to Presidents Franklin Roosevelt and Harry Truman.

Born in Everett, Massachusetts, in 1890 (but no relation to the family by the same name that would produce two presidents), Bush earned a doctorate in engineering offered jointly by the Massachusetts Institute of Technology and Harvard University in 1916. From 1919 through 1938, he was an MIT faculty member, rising to become dean of engineering and then vice president.

In 1939, Bush became president of the Carnegie Institution of Washington, which distributed grants for scientific research, and was also appointed to the National Advisory Committee for Aeronautics. Thereafter, for nearly a decade, he directed, chaired, or served on every important government body engaged in ensuring that science and technology would be applied to national defense: the National Advisory Committee for Aeronautics (1939–1941), the National Defense Research Committee (1940–1944), the Office of Scientific Research and Development (1941–1947), the Joint Committee on New Weapons and Equipment of the Joint Chiefs of Staff (1942–1946), the Joint Research and Development Board (1946–1947), and the Research and Development Board (1947–1948).

In addition to his unparalleled achievements in coordinating the use of science and technology for military purposes, Bush foresaw broader applications for these instruments of human ingenuity. In an article ("As We May Think") in the July 1945 issue of *The Atlantic Monthly*, he anticipated personal computers and the internet with his description of a future information storage and retrieval system, the "memex." Still, his assessments of technological advances were sometimes flawed. Although he recognized the importance of guided missiles and promoted their development, he doubted the practicality of intercontinental ballistic missiles. In October 1948, on the eve of his departure as chairman of the Research and Development Board, he wrote Secretary of Defense James Forrestal: "I take very little stock indeed in the continent-to-continent missile . . . I think these things will be just too expensive and too inaccurate to use, even if they could be built." But whatever his limitations in forecasting the use of technology, no single individual contributed more than Vannevar Bush to making science and technology serve the interests of national security. As the leading government advisor on science and technology throughout the 1940s, he helped to assure victory in World War II and prepare the United States for the Cold War struggle ahead.[1]

After the war, spurred by the belief that the United States must always be on the cutting edge of weapons technology, the wartime partnership between science and the military became a permanent feature of the nation's defense posture, and research and development became one of the most important functions of the armed forces. Scientists and engineers, operating largely in the private sector, became integral parts of a huge federally funded research and development structure. They sat on advisory boards at all levels of the national security establishment—the White House, the Office of the Secretary of Defense, and the services' headquarters as well as their weapons development organizations. They also staffed special quasi-government organizations, such as the RAND Corporation, set up to exploit science and technology for military purposes. Finally, they applied their knowledge and skills in the flood of research and development contracts let by the military services during the Truman and Eisenhower years.

Between 1945 and 1960, spending on research and development reflected the commitment to technological superiority. In FY 1949, during the depths of the postwar demobilization, outlays for military R&D were still at a high level—$762 million, almost thirty times the amount for FY 1940. During the Korean War, outlays for research and development rose to an average of over $1.2 billion annually, an average of 1.9 percent of total Defense Department outlays in those three years. In the first two years after Korea, R&D spending remained at about $1.5 billion annually, the wartime peak. Beginning in the mid-1950s, it began to increase steadily—to $6.9 billion in FY 1961, more than 7 percent of military outlays that year.[40]

Within the military establishment, significant changes regarding research and development organization and management accompanied the upsurge in funding. Previously subordinate to and subsumed in the services' procurement and production functions, research and development achieved varying degrees of organizational equality and independence, first in the Air Force and then in the other two branches, sometimes after prolonged battles. In all the services, R&D came to be identified in a separate budget category and congressional appropriation, assembled annually in formal programs, and managed and administered by large, specialized staffs.

As with science and for essentially the same reasons, World War II initiated fundamental changes in the relationship between the military and industry. In May 1940, as German armies were rolling through France, President Roosevelt called for the production of 50,000 aircraft to meet the threat he believed confronted the United States.[41] By the end of the war, American industry had far exceeded the president's initial objective. It manufactured for the military services more than 86,000 planes in 1943, more than 96,000 in 1944, and a total of just over 300,000 aircraft from 1940 through 1945.[42] Other types of war materiel were produced in similarly enormous quantities—more than 1,250 major combatant vessels, almost 90,000 tanks, over 500,000 artillery pieces, and a staggering 3 million plus motorized military transport vehicles.[43] In all, between June 1940 and June 1946, the U.S. government spent about $184 billion on munitions, including major weapon systems such as aircraft and ships, but excluding food and clothing.[44] Since big companies possessed the most experienced and skilled managerial and technical personnel as well as the largest physical plants able to meet government needs most rapidly, they received a disproportionate share of the value of war contracts. Of the 18,000 prime contractors, 100 captured two-thirds of the business and 33 almost half. General Motors led all contractors with 8 percent.[45]

To start production quickly and to provide for the huge quantities needed, the government took steps to encourage industry's participation, implementing many measures even before the United States entered the war. These included relaxation of rigid pre-emergency contracting procedures, extension of advance and progress payments and tax breaks to contractors, and government financing of the plants and equipment necessary for expanding production. Among these initiatives, the changes in contract regulations would have the most far-reaching effects. Prior to the war, the government used a system of advertising and sealed bids to award contracts. Considered to be democratic and to promote competition, these procedures had been in place for much of the nation's history, except during wartime. In World War II, the government authorized negotiated sole-source contracts to be substituted for contracts concluded through the more cumbersome and time-consuming process of advertising and competitive bidding. Moreover, cost-plus-fixed fee and other contract forms could be used rather than the usual fixed-price contracts available under the traditional system. While the wartime modifications to the prewar contracting protocol and other actions taken to increase production worked very well, an important effect was to transfer the business risks previously assumed by the private contractor to the government and the American taxpayer.[46]

Following World War II, as in previous conflicts, American industries that had converted to producing military materiel rapidly returned to manufacturing goods for the commercial economy. Before the end of the war, however, American leaders recognized that the military's arsenals and shipyards would be unable to equip the substantial peacetime force they envisioned with sufficient quantities of the most advanced weapons, and that a well-developed arms industry would be necessary. Consequently, they left in place the measures instituted to facilitate the large-scale and rapid production required by the war and continued to foster the government-industry ties that it generated. This government-industry alliance, whose distinguishing feature was the transfer of risk from the private to the public sector, was so firmly in place by the time he left office in January 1961 that President Eisenhower, in his farewell address to the American people, warned against the potential for abuse of power by the combination of interests that he called the "military-industrial complex."[47]

But at the end of World War II, few worried that the government-science-industry connection would become too powerful. On the contrary, most were concerned that the bonds cemented during the war would dissolve, weakening the nation's ability to confront and defeat future aggressors. Thus, American leaders sought to form a postwar security structure that would preserve and further solidify that alliance, a union that would be able to harness rapidly changing technology to the service of national defense.

Endnotes

1. In 2011, there were 193 member states.
2. For the domestic impact of World War II in the United States, see David M. Kennedy, *Freedom from Fear: The American People in Depression and War, 1929–1945.*
3. The United States did not entirely avoid international political and military agreements. During the interwar period, it entered into naval arms limitation and other treaties that involved primarily the Pacific and East Asia.
4. For a discussion of Roosevelt's concept of the Four Policemen and his attitude toward collective security generally, see Robert A. Divine, *Roosevelt and World War II*, 49-71.
5. Historians have written extensively and well on the controversial issue of the origins of the Cold War. Among the best studies are: John Lewis Gaddis, *The United States and the Origins of the Cold War, 1941–1947*; Daniel Yergin, *Shattered Peace: The Origins of the Cold War and the National Security State*; Melvyn P. Leffler, *A Preponderance of Power: National Security, the Truman Administration, and the Cold War*; and Michael J. Hogan, *Cross of Iron: Harry S. Truman and the Origins of the National Security State, 1945–1954*. Excellent one-volume surveys of the half-century history of the Cold War are John Lewis Gaddis, *The Cold War: A New History*; Melvyn P. Leffler, *For the Soul of Mankind: The United States, the Soviet Union, and the Cold War*; and Walter LaFeber, *America, Russia, and the Cold War, 1945–2006*.
6. Yergin, *Shattered Peace*, 233-35, 279-82.
7. Ibid., 283.
8. Ibid., 294.
9. Quoted in Herbert Feis, *From Trust to Terror: The Onset of the Cold War, 1945–1950*, 240.
10. Steven L. Rearden, *The Formative Years, 1947–1950*, 10-11.
11. ANZUS (from the initials of the three signatories—Australia, New Zealand, the United States) was established in 1951; the Southeast Asia Treaty Organization (SEATO) in 1954; and the Baghdad Pact in 1955 (reorganized as the Central Treaty Organization, or CENTO, in 1959).
12. Rearden, *Formative Years*, 446-56, 521-36.
13. The best brief descriptions of the origins and content of the National Security Act of 1947

are Roger R. Trask and Alfred Goldberg, *The Department of Defense, 1947–1997: Organization and Leaders*, 1-14; and Rearden, *Formative Years*, 23-27.

14. In addition to the president, the members of the National Security Council were the secretaries of state and defense, the secretaries of the three military departments, and the chairman of the National Security Resources Board. Although not a member, the director of the Central Intelligence Agency reported to the National Security Council.

15. Ibid., 11.

16. In the years covered by this volume, the federal government's fiscal year began on 1 July and ended on 30 June of the next calendar year and was identified by the latter year. Beginning in FY 1977, the fiscal year began on 1 October and ended on 30 September of the next calendar year.

17. Budget and force level figures are from table 1 (Total Federal Outlays, FY 1945–2009) and table 4 (Department of Defense Manpower, FY 1940–2005), in Historical Office, Office of the Secretary of Defense, *Department of Defense Key Officials, 1947–2004*, 80, 90; and Scott Sigmund Gartner, table Ed146-154 (National defense outlays and veterans' benefits: 1915–1995), in *Governance and International Relations*, Vol. 5, Pt. E, *Historical Statistics of the United States: Earliest Times to the Present, Millennial Edition*, ed. Susan B. Carter et al., 5-367.

18. Table 1 (Total Federal Outlays, FY 1945–2009), in *Department of Defense Key Officials*, 80.

19. Table 4 (Forces in Being, 1950–1952), in Walter S. Poole, *The Joint Chiefs of Staff and National Policy, 1950–1952*, 71; and table 8 (Actual Force Levels of U.S. Armed Forces: 1952–1956), in Robert J. Watson, *The Joint Chiefs of Staff and National Policy, 1953–1954*, 84. Major combatant vessels included aircraft carriers, battleships, cruisers, destroyers, destroyer escorts, and submarines.

20. Trask and Goldberg, *Department of Defense*, 171.

21. Table 1 (Total Federal Outlays, FY 1945–2009), in *Department of Defense Key Officials*, 80.

22. Trask and Goldberg, *Department of Defense*, 171.

23. Rearden, *Formative Years*, 350. For the concept of deterrence and U.S. postwar military planning before the end of World War II, see Michael S. Sherry, *Preparing for the Next War: American Plans for Postwar Defense, 1941–1945*, passim.

24. Steven L. Rearden, "Congress and National Defense, 1945–1950," *The United States Military under the Constitution of the United States, 1789–1989*, ed. Richard H. Kohn, 281.

25. Budget figures are from the tables in Rearden, *Formative Years*, 333, 360; Doris M. Condit, *The Test of War, 1950–1953*, 284; Richard M. Leighton, *Strategy, Money, and the New Look, 1953–1956*, 113, 254, 629; and Robert J. Watson, *Into the Missile Age, 1956–1960*, 32, 100, 153, 320, 359.

26. Ltr, Karl T. Compton, Chairman, Research and Development Board, to Capt. Walter R. Hedrick, Special Projects Office, Office of the Secretary of the Air Force, 27 July 1949, folder 110 Air Force, box 504, entry 341, RG 330.

27. Dwight D. Eisenhower, "Letter to the Secretary of Defense on National Security Requirements," 5 January 1955, *Public Papers of the Presidents of the United States: Dwight D. Eisenhower, 1955*, 3.

28. Alex Roland, *The Military-Industrial Complex*, 4.

29. Martin van Creveld, "War and Technology," *Footnotes* (Newsletter of Foreign Policy Research Institute) 12, no. 25 (October 2007).

30. Richard Overy, *Why the Allies Won*, 242-43; and George M. Watson, Jr., "Building Air Power," chap. 8 in *Winged Shield, Winged Victory*, Vol. I, *A History of the United States Air Force*, ed. Bernard C. Nalty, 240-43. Some historians do not consider advanced weapons technologies to have been decisive. See, for example, Alex Roland, "Science and War," in *Historical Writing on American Science: Perspectives and Prospects*, ed. Sally Gregory Kohlstedt and Margaret W. Rossiter, 265. Roland views the atomic bomb as a possible exception. Its role in ending the war has been the subject of extensive, long-running, and heated controversy. To sample this debate, see Robert James Maddox, ed., *Hiroshima in History: The Myths of Revisionism*; and Samuel J.

Walker, "Recent Literature on Truman's Atomic Bomb Decision: A Search for Middle Ground," *Diplomatic History* 29, no. 2 (April 2005): 311-34.
31. Watson, "Building Air Power," 243.
32. Michael H. Gorn, *Harnessing the Genie: Science and Technology Forecasting for the Air Force, 1944–1986*, 35-42.
33. Elliott V. Converse III, *Circling the Earth: United States Plans for a Postwar Overseas Military Base System, 1942–1948*, 163.
34. Senate, Report of the Subcommittee on War Mobilization to the Committee on Military Affairs, United States Senate, *The Government's Wartime Research and Development, 1940–1944*, pt. II, 79th Cong., 1st sess., 1945, Subcommittee Rpt. No. 5, 5.
35. For the mobilization of American scientific resources in World War II, see James Phinney Baxter III, *Scientists Against Time;* Irvin Stewart, *Organizing Scientific Research for War: The Administrative History of the Office of Scientific Research and Development*; A. Hunter Dupree, "The *Great Instauration* of 1940: The Organization of Scientific Research for War," in *The Twentieth Century Sciences: Studies in the Bibliography of Ideas*, ed. Gerald Holton, 443-67; Larry Owens, "The Counterproductive Management of Science in the Second World War: Vannevar Bush and the Office of Scientific Research and Development," *Business History Review* 68 (Winter 1994), 515-76; and G. Pascal Zachary, *Endless Frontier: Vannevar Bush, Engineer of the American Century.*
36. The National Defense Research Committee continued in an advisory role to the Office of Scientific Research and Development.
37. Stewart, *Organizing Scientific Research for War*, 7-9, 18, 35-40, and 332-33.
38. Plans Office, R&D Group, Logistics Division, Army General Staff, table (Department of Defense Research and Development Allocations, FY 1944–FY 1951), 8 November 1948, folder Research and Development, FY 1949, FY 1948, box 133, entry 26 (Office of the Under Secretary of the Army; Security-Classified General Correspondence, 1947–1954), RG 335 (Records of the Secretary of the Army), Archives II.
39. Stewart, *Organizing Scientific Research for War*, 47, 49; and Zachary, *Endless Frontier*, 161.
40. Table 9.7 (Summary of Outlays for the Conduct of Research and Development: 1949–2002), in Historical Tables, Fiscal Year 2002, *Budget of the United States Government*, 170. For FY 1961, the Eisenhower administration had requested $3.9 billion for RDT&E, almost 10 percent of its total Defense Department budget submission of $40.6 billion. See Watson, *Missile Age*, 348.
41. Bernard C. Nalty, "Reaction to War in Europe," chap. 6 in *Winged Shield, Winged Victory*, 172.
42. Irving Brinton Holley, jr., *Buying Aircraft: Matériel Procurement for the Army Air Forces*, 548.
43. Robert H. Connery, *The Navy and the Industrial Mobilization in World War II*, 3; and Harry C. Thomson and Lisa Mayo, *The Ordnance Department: Procurement and Supply*, 101, 242, 296.
44. Procurement Branch, Industrial College of the Armed Forces, *The Economics of National Security: Procurement,* 2.
45. James F. Nagle, *A History of Government Contracting*, 2d ed, 426.
46. Nagle, *Government Contracting*, 391-93, 399-406, 415-26; Robert Higgs, "Private Profit, Public Risk: Institutional Antecedents of the Modern Military Procurement System in The Rearmament Program of 1940–1941," in *Sinews of War: Essays on the Economic History of World War II,* ed. Geoffrey T. Mills and Hugh Rockoff, 166-98; Commission on Government Procurement, app. G (Historical Development of the Procurement Process), *Report*, 170-1; and John Perry Miller, "Military Procurement Policies: World War II and Today," *American Economic Review* 42, no. 2 (May 1952): 458-59.
47. Dwight D. Eisenhower, "Farewell Radio and Television Address to the American People," 17 January 1961, *Public Papers of the Presidents of the United States: Dwight D. Eisenhower, 1960–1961*, 1035-40. Eisenhower's notion of the "military-industrial complex" included more

than the military and industry. In the same speech, he separately alerted the public to the existence of a "scientific and technological elite." The president also included Congress in this conglomeration of power. For excellent discussions of the origins, meaning, and evolution of the term "military-industrial complex," see Alex Roland's previously cited work of the same title, or his article "The Grim Paraphernalia: Eisenhower and the Garrison State," in *Forging the Shield: Eisenhower and National Security for the 21st Century*, ed. Dennis E. Showalter, 13-22. Roland's *The Military-Industrial Complex* also contains a bibliographic essay surveying the extensive literature on the subject. Among the best histories of the "military-industrial complex" in America are Benjamin Franklin Cooling, *Gray Steel and Blue Water Navy: The Formative Years of America's Military-Industrial Complex, 1881–1917*, and especially the works of Paul A. C. Koistinen. These include *The Military-Industrial Complex: A Historical Perspective*, and the four-volume (to date) series: *Beating Plowshares into Swords: The Political Economy of American Warfare, 1606–1865*; *Mobilizing for Modern War: The Political Economy of American Warfare, 1865–1919*; *Planning War, Pursuing Peace: The Political Economy of American Warfare, 1920–1939*; and *Arsenal of World War II: The Political Economy of American Warfare, 1940–1945*.

I. Sources: Official biography of Vannevar Bush, atch to National Military Establishment Press Release No. 176-48, 5 October 1948, Historical Office, Office of the Secretary of Defense; A. Hunter Dupree, *Science in the Federal Government: A History of Politics and Activities to 1940*, 375; and G. Pascal Zachary, *Endless Frontier: Vannevar Bush, Engineer of the American Century*, 261-65, 267-69, 316-18, 337 (quotation).

CHAPTER II

Organizing for National Security: OSD and Acquisition, 1945–1949

In mid-November 1948, Rear Adm. Morton L. Ring, vice chief of the Office of Naval Material, spoke to students and faculty of the Industrial College of the Armed Forces about the difficulties of achieving coordinated procurement in the armed forces as mandated by the National Security Act of 1947. The act, bringing together the three military services (the newly established Air Force joining the Army and Navy) in the National Military Establishment headed by a civilian secretary of defense, had been in effect for more than a year. "Coordination," Admiral Ring told his audience, "is one of the most loosely used and misused words in the English language. . . . It is rather easy to talk of coordination and to recommend coordination, but the actual task of coordination is a very difficult day-to-day operation. . . . It cannot be achieved by merely decreeing, 'Let there be coordination'. . . . Implicit in any discussion of coordination is the assumption that coordination is desired. . . . It is not something which can be obtained by forced growth."[1] Ring's caution may have been typical of many Navy officers' lack of enthusiasm for defense "unification"—centralization under a civilian secretary with the services retaining their identities in separate departments—but it also spoke to the practical difficulties involved in effecting coordination. Ring saw acquisition primarily from his service's vantage point in 1948. But, in less than a year, he would be assigned to the Munitions Board and would be challenged to adopt a new perspective. The Munitions Board, the Research and Development Board (RDB), and the Joint Chiefs of Staff (JCS) were the three statutory agencies created by the National Security Act to coordinate acquisition in the armed forces under the direction of the secretary of defense. As the Munitions Board's director of supply, Admiral Ring would be expected to approach materiel issues from the broader perspective of the Department of Defense.[2]

INDUSTRIAL COLLEGE OF THE ARMED FORCES

Established in 1924 in response to the mobilization difficulties experienced by the United States during World War I, the Army Industrial College trained Army, Navy, and Marine Corps officers to manage industrial and other resources in both war and peace. By World War II, the college had set important precedents for acquisition education in later years. It had adopted the case-study method for its 10-month course of instruction, an approach to teaching likely borrowed from the Harvard Business School. Courses at the Army Industrial College typically required students to organize into committees to develop solutions to case problems. The college also hosted conferences, invited prominent individuals to deliver lectures, and organized trips to industrial sites in Washington, D.C., and Pittsburgh.

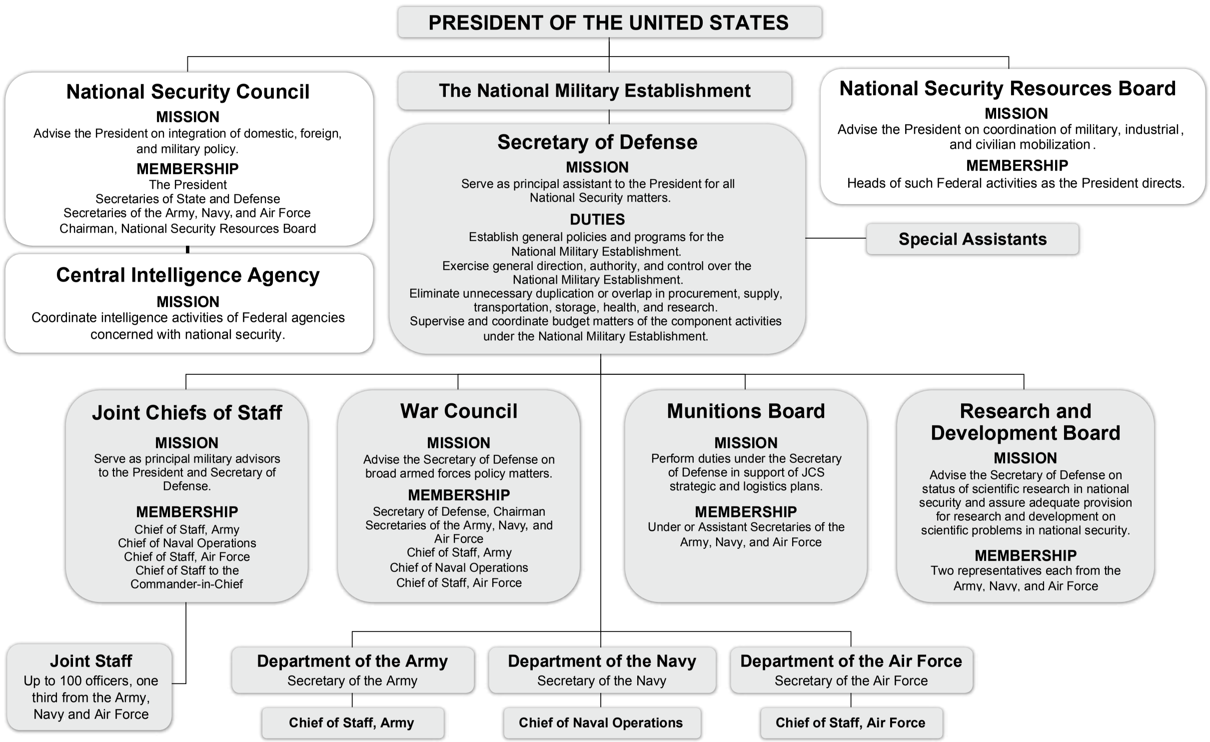
The Army Industrial College closed for a time during World War II, but War Department committees set up during the war made several recommendations regarding the college's future. Among these were admitting civilians and reserve officers, instituting courses in finance and contracts, and strengthening the college's ties with industry. One of the committees also proposed that acquisition management become a separate specialization for officers and that it receive equal status with other military career fields. The committee also suggested that the college be renamed to better reflect its joint-service mission.

In September 1946, the Industrial College of the Armed Forces (ICAF) began classes at Fort Lesley J. McNair, Washington, D.C., with an expanded faculty and revised curriculum, having moved from the old quarters of the Army Industrial College in the Munitions Building on Constitution Avenue. In 1948, Secretary of Defense James Forrestal issued a charter for the college, removing it from the Army's jurisdiction and formally reconstituting it "as a joint educational institution under the direction of the Joint Chiefs of Staff." In 1976, ICAF became part of the newly established National Defense University. Over the years since World War II, the college's curriculum has changed focus—from an emphasis on industrial mobilization during wartime to a concentration on materiel acquisition and joint logistics and their integration into national security strategy.[1]

"Tempo 5," home of the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 1946–1960.
Courtesy, Special Collections, National Defense University Library.

Coordination was the overriding theme of the National Security Act. It provided for the "authoritative coordination and unified direction" of the three military departments by the civilian secretary of defense and for "coordination" of National Military Establishment activities with those of other organizations created by the act—the National Security Council, the Central Intelligence Agency, and the National Security Resources Board. What coordination in the military establishment would mean in practice would only be revealed as the years passed, but it was expected to achieve several objectives. One was to integrate military plans and operations. Another was to mesh military policies with the nation's foreign and economic policies. Yet another, viewed by some as the most important (especially in Congress) was to save money. To fulfill this latter purpose, the act charged the secretary of defense to "[t]ake appropriate steps to eliminate unnecessary duplication or overlapping in the fields of procurement, supply, transportation, storage, health, and research." The objectives of integration and economy were also either directly stated or implied in the duties assigned under the act to the Joint Chiefs of Staff, the Research and Development Board, and the Munitions Board.[3] This chapter describes how the secretary of defense and the statutory agencies set up to assist him sought to bring about integration and economy in acquisition, a process that until 1947 had been largely left to the individual services, operating independently. Although some progress was made toward achieving these goals, the desired outcomes were still far from being realized by the end of the decade.

ORGANIZATION FOR NATIONAL SECURITY
NATIONAL SECURITY ACT OF 1947
September 1947



Source: Adapted from Chart 2 (Organization for National Security, National Security Act of 1947, 30 September 1947), in Trask and Goldberg, *The Department of Defense, 1947–1997*, 10.

COORDINATION OF RESEARCH AND DEVELOPMENT PRIOR TO THE NATIONAL SECURITY ACT

American political leaders, scientists and engineers, and the military had worked together effectively in World War II to apply science and technology to warfare. Nearly all were convinced that advanced weapons would probably be decisive in future wars and that the United States must stay ahead of other nations in such technologies. For this reason, they sought to continue the wartime partnership into the postwar period. But they disagreed over who should control advanced weapons development and the type of organization that should administer it. Many in the scientific community, including Vannevar Bush, who directed the Office of Scientific Research and Development during the war, believed that trained experts like themselves should be in charge, free from military and, if possible, government control generally. In their view, military officers tended to focus on improving existing weapons in their own service and ignored opportunities for breakthrough advances in weapons technology. Certain that they best understood the potential of new weapons, some scientists also thought they should participate as equals with military officers in devising strategy. The uniformed military, while eager to enlist scientists in weapons research and initially willing to grant them some autonomy, ultimately proved unwilling to let scientists participate in strategy formulation or to surrender authority over their research and development programs.[4]

By late 1944, the military and scientists were able to agree on an organizational mechanism to sponsor and coordinate postwar military research. Established at the request of the War and Navy Departments in November 1944, the Research Board for National Security was to operate under the private National Academy of Sciences, be funded directly from military appropriations, and comprise 40 members, half from the private sector and half from the War and Navy Departments. The board's first chairman, appointed by the president of the National Academy of Sciences, was Karl Compton, a physicist and president of the Massachusetts Institute of Technology. Compton chaired an executive committee that included two other nongovernment civilian scientists and two high-ranking military officers. Much like the Office of Scientific Research and Development, the board was to operate by letting research contracts to academic and industrial laboratories; the services would develop the resulting weapons concepts. In March 1945, while the board was still getting organized, President Roosevelt halted its operation on the advice of Bureau of the Budget Director Harold D. Smith, who believed that it would not be sufficiently accountable to the president or Congress. Attempts to revive the board continued for almost a year, but to no avail.[5]

By the spring of 1946, the United States still lacked a high-level, independent coordinating agency for military research and development that Bush and many others thought essential. The Research Board for National Security had expired.

The Office of Scientific Research and Development, never designed to be a permanent organization, had begun terminating or transferring contracts to the War and Navy Departments even before the war ended. To fill the gap, the Joint Chiefs of Staff proposed to convert their Joint Committee on New Weapons and Equipment, chaired by Bush with military officers as its other members, into a Joint Research and Development Committee. But the JCS recommendation was not followed. Bush objected that the committee would be advisory only and, unlike the Office of Scientific Research and Development, have no independent authority of its own. Finally, with pressures for defense unification increasing, Secretary of War Robert P. Patterson and Secretary of the Navy James Forrestal established the Joint Research and Development Board (JRDB) on 6 June 1946, with Bush as its chairman.[6]

The Joint Research and Development Board held its first meeting on 3 July 1946. In addition to Bush, it included two members from each military department. General Jacob L. Devers of the Army Ground Forces and General Carl Spaatz of the Army Air Forces represented the War Department; the Navy assigned W. John Kenney, an assistant secretary, and Admiral Dewitt C. Ramsey. The board reached its decisions by simple majority vote of the five members and, like the wartime Office of Scientific Research and Development, conducted its work through committees, eventually 10 in number, each with subordinate panels. Some committees were organized by weapon type or by type of warfare, such as guided missiles or biological warfare, while others were set up by general scientific field or activity, such as geophysical science or human resources. Normally, each committee had a civilian chairman from the private sector, two or three other nongovernment members, a roughly equal number of military or civilian representatives from the two military departments, and sometimes specialists from other government agencies. The committees possessed considerable autonomy in their own fields. If a decision taken by a committee did not involve a "major" policy or strategy issue, and if none of its members or associate members dissented, then its authority was the same as a board decision. All board and committee members, including Bush who continued as president of the Carnegie Institution of Washington, served part time; the committees augmented their numbers with associate members from the services and consultants from civilian life.[7]

Under its charter, the Joint Research and Development Board had two main responsibilities. One was to "coordinate all research and development activities of *joint interest* to the War and Navy Departments . . ."[8] Although the war was over, military research and development programs continued to be extensive. In FY 1947, they amounted to $515 million (about 4 percent of the combined War and Navy Department budgets of $12.8 billion) and involved approximately 11,000 individual projects.[9] But only a fraction of these would have concerned both departments. The board sought to effect coordination by allocating responsibility to one service for a research and development program of interest to both, thereby eliminating "unnecessary or wasteful duplication or overlapping." To accomplish its second major task, integration of research and development with strategy, the board established a "Policy Council" made up of senior officers who were to keep the committees abreast of current war planning. The committees, in turn, would provide the JCS committee responsible for war plans with estimates of probable technical developments in their respective areas.[10]

Bush insisted that the Joint Research and Development Board, unlike the earlier, strictly advisory Joint Committee on New Weapons and Equipment, have real authority. He obtained Patterson's and Forrestal's consent to allow the board to speak for them. At its first meeting, Patterson confirmed the scope of the board's authority, stating that "the signature of the Chairman on the action of the Board will be carried out 'ipso facto' by both the War and Navy Departments. . . ."[11] Nonetheless, Bush thought the board's authority should be limited. He told the two secretaries that it "should have no authority regarding the internal affairs of either department. . . ." To Bush this meant that the military services, not the board, would continue to originate research and development programs. Citing the hypothetical example of guided missiles, he intended for the board to act as an adjudicator among potentially competitive work by allocating responsibility to develop a particular missile to one service or the other. That service would then budget for and determine which of its subordinate organizations would run the program. Nor would the board attempt to devise an overarching research and development plan for the services, although its committees might recommend an integrated program for their respective fields. If the board spotted omissions in the services' research and development programs, it could only advise the department secretaries that such gaps existed.[12] When Bush spoke at the Industrial College of the Armed Forces in September 1946, he admitted that a significant number of problems existed with respect to research and development: "[W]e have over-expansion and duplication in many fields. We have the staking of claims. We have uncontrolled competition and we have appeals to the public [for support]." But he was nevertheless optimistic that the Joint Research and Development Board would provide the means to resolve these difficulties.[13]

Measured by its responsibility to coordinate military research and development, the Joint Research and Development Board could claim little success by the time its successor, the Research and Development Board was established by the National Security Act in September 1947. Despite the pressing need for action that Bush had described at the Industrial College of the Armed Forces the previous year, the Joint Research and Development Board had not allocated responsibility for any program, nor had any of its committees recommended such allocation. The board's Committee on Guided Missiles reported in mid-1947 that thus far it had not found an instance of "obviously unwarranted duplication," although the committee also noted that it had not thoroughly surveyed the services' ongoing missile projects.[14] At about the same time, Bush informed Patterson and Forrestal that only two dissents to any committee action had been forwarded to the board and that the board itself had not encountered any "important deadlocks to resolve. . . ."[15] One reason for the apparent lack of activity was that the board spent much of its first year getting organized, establishing committees and panels, and recruiting qualified scientists and engineers to staff them and its own secretariat. One of the most active committees, the Committee on Aeronautics, met six times by mid-1947. In contrast, because the Army's chief of ordnance thought sufficient coordination was taking place at the service level, he opposed establishing an ordnance committee (even though the board wanted one and ordnance accounted for 18 percent of the Army's and Navy's research and development budgets), and one was not authorized until March 1947.[16] The Joint Research and Development Board itself met only nine times between June 1946 and December 1947, the month of the first meeting of its successor, the Research and Development Board.

Although the Joint Research and Development Board had little impact on specific service research and development programs, it established patterns of operation and procedures that would influence the effort to integrate military research and development through the Korean War. First, the board set up a system for the services to report on individual research and development projects. These "project cards," although varying with respect to the amount and quality of data they contained, were accessible to all committee members and associate members.[17] Thus, the services had to share information with each other and with other agencies. Second, as the board's committees and panels reviewed individual projects, their sponsors had to defend them—or at least be ready to defend them—against criticism from other committee members.[18] Third, the Joint Research and Development Board's organizational structure would be adopted almost intact by the Research and Development Board, with many of its committees as well as their chairmen continuing to function under the new board. The Research and Development Board also adopted its predecessor's philosophy that the committees should have substantial autonomy. Finally, and of great importance, the Joint Research and Development Board linked top-level American scientists and engineers to the military and to the concept that the services' research and development programs should be coordinated and integrated.

The nearly 400 scientists and engineers who served the Joint Research and Development Board in one capacity or another included some of the most distinguished names in those professions. In addition to Bush, these included Karl Compton; James B. Conant, president of Harvard University and chairman of the National Defense Research Committee during the war; J. Robert Oppenheimer, who had directed development of the atomic bomb; I. I. Rabi, winner of the 1944 Nobel prize in physics; and Julius A. Stratton, director of the Research Laboratory of Electronics at MIT (the successor to the famous World War II Radiation Laboratory, the RadLab). Many would continue their association with the Research and Development Board, the military departments, and other government agencies in the years to come—their personal prestige attracting others to public service.

THE RESEARCH AND DEVELOPMENT BOARD

Organization and Operation

In the National Security Act, Congress chose to continue the established pattern of coordinating military research and development through a board structure. Like its predecessor, the Research and Development Board consisted of two representatives from each of the (now three) military departments and was chaired by a civilian. Bush served in the post until October 1948. Karl Compton, who succeeded him and was the board's first full-time chairman, resigned in November 1949 because of poor health. The act, and the board's governing directive issued by Forrestal, who had become the first secretary of defense in 1947, provided for an organization with greater permanence and much broader responsibilities than its predecessor. The Research and Development Board was, first of all, a statutory agency. The secretaries of war and Navy had the authority to abolish the Joint Research and Development Board; only Congress could eliminate the Research and Development Board. Secondly, the RDB had broader authority than the Joint Research and Development Board—all military research and development activities, not just those of joint-service interest, came under its purview. Third, while the Research and Development Board continued to perform some of the same duties as the JRDB, such as recommending ways to coordinate military research and development and allocating responsibility among the services for particular programs, it had new tasks: to advise the Joint Chiefs of Staff with regard to the interaction of research and development with strategy, and "to prepare a complete and integrated program of research and development for military purposes."[19]

In some ways, however, the Research and Development Board, which operated "under the direction" of the secretary of defense, was not as powerful as the Joint Research and Development Board. Forrestal took office believing that progress toward unification (or, in his terminology, "integration") would have to be slow and evolutionary and that he should seek the departments' voluntary cooperation.[20] In keeping with that approach, his implementing directive of December 1947 did not give the Research and Development Board or its chairman wide latitude. The instruction required that "major" policy issues be referred to him, and denied the board any power to "direct or control the internal administration of the research and development activities and programs of the several [military] departments. . . ." The directive also specified voting procedures that gave Bush less power as RDB chairman than he had possessed in the Joint Research and Development Board post. In the latter organization, he could cast the deciding vote when the two services split. But with three services represented on the Research and Development Board, the voting protocol changed. According to the new rules, the chairman and at least two of the services must vote together to decide an issue. (This requirement meant that the minimum deciding vote would be 5–2 because each service had two representatives who would presumably vote as a bloc.) In cases where the chairman sided with one service in the minority, the resulting 3–4 vote had to be forwarded to the secretary of defense for decision. In addition to strengthening the services against the chairman, the voting method reinforced service independence in another way. Lawrence R. Hafstad, the board's first executive secretary and previously director of research at the Applied Physics Laboratory at Johns Hopkins University, noted that it effectively prevented "any two of the Departments from ganging up on the third."[21]

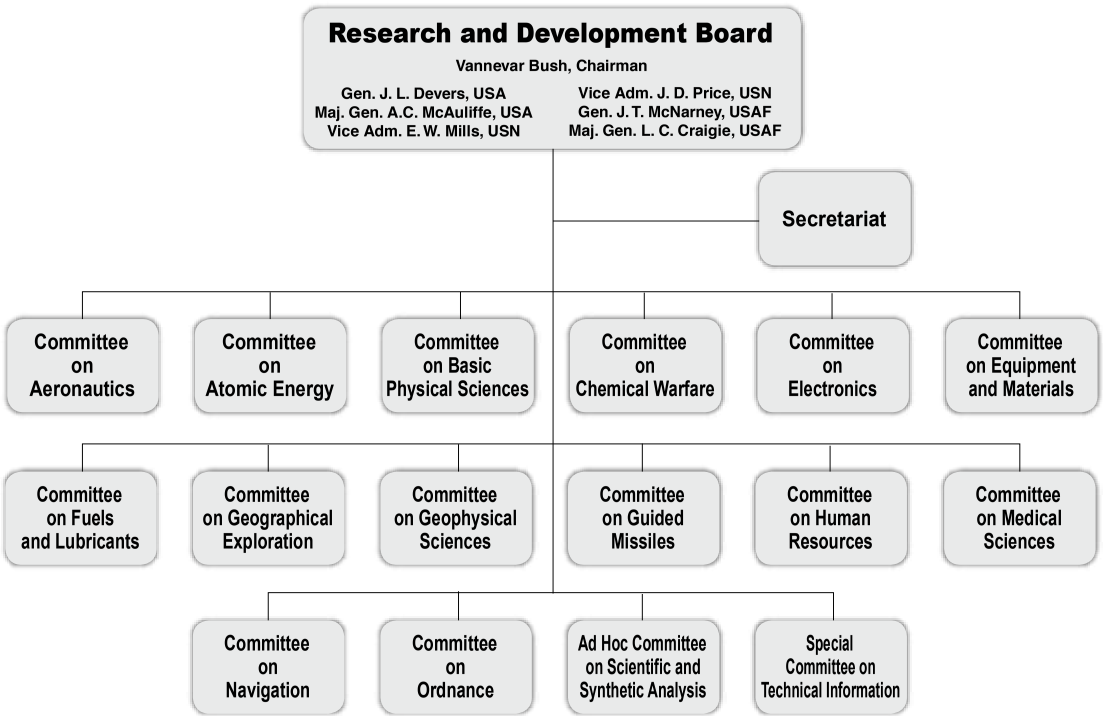
Left to right: Karl T. Compton, incoming chairman, Research and Development Board; Secretary of Defense James V. Forrestal; Vannevar Bush, outgoing chairman; and Secretary of the Navy John L. Sullivan at a dinner at the Naval Gun Factory in late 1948.

The Research and Development Board held its first meeting on 19 December 1947; in a reflection of continuity, the meeting was recorded as the tenth (the JRDB had met nine times).[22] By mid-1950, the Research and Development Board's full-time staff numbered over 300, primarily civilian government employees but also 60 military personnel. In 1949, it had 16 committees, 68 panels, and 156 subpanels and working groups, using the services of as many as 2,500 part-time consultants drawn both from outside the government and from the military departments.[23] Finding enough qualified scientists and engineers to staff its committees and panels strained both private-sector and Defense Department resources.[24] Compton reported early in 1949 that some of the committees' military representatives were "so unsatisfactory that some of the civilian members of the committees are coming to feel that their services are scarcely worthwhile."[25]

To coordinate research and development among the services and to prepare an integrated program related to strategy, the board produced several key documents. The Program Guidance was a consolidated report summarizing the technical status of the military departments' research and development programs that were reviewed by the board's committees. Its purpose was to assist the services in developing their research and development budget estimates by identifying gaps in their research and development work and recommending shifts in emphasis.[26] A second and more important source of guidance was the board's Master Plan for Research and Development which established research and development priorities by first identifying eighteen warfare categories (e.g., strategic air, air defense, antisubmarine, land combat). Next, within each category, the plan listed supporting "technical objectives." For example, one of the twenty technical objectives for strategic air operations in the first fully developed Master Plan (February 1949) was new and improved bombers able to deliver atomic bombs in any weather. Among the sixteen technical objectives in antisubmarine warfare was new and improved "antisubmarine submarines" (attack submarines). Each technical objective, in turn, received an "importance rating" based on a JCS assessment of the relative strategic value of each warfare category and on Research and Development Board and military department evaluations of the "adequacy" of existing weapons and the "promise" research and development might have for improving them. Thus, reflecting the high priority that strategic air capabilities had attained in U.S. military planning during the late 1940s, fifteen of the twenty technical objectives in that category received an "A" rating, five a "B," and none the lowest, "C" rating. On the other hand, of sixteen objectives in the less strategically vital land combat operations category, only three had "A" ratings (one was landmines), eight "B," and five "C."[27]

To support strategic planning, the Research and Development Board provided the JCS with projected advances in weapons technology that were expected to occur within the next fifteen years in the form of Consolidated Technical Estimates. The board forwarded the first of these estimates to the JCS in September 1948, and the second (organized by the warfare categories and technical objectives of the Master Plan) a year later. The accuracy of the forecasts proved to be uneven. In the guided missile field, for example, the 1949 estimate that surface-to-air and air-to-air missiles would be "basic" air defense weapons within five years was not far off the mark. But neither of the two estimates addressed the prospect for nuclear-powered submarines (*Nautilus* would be launched in January 1954).[28]

RESEARCH AND DEVELOPMENT BOARD
September 1948



Source: Adapted from Chart 3 (Organization of the Research and Development Board) in Lawrence R. Hafstad, "Coordination of Research and Development," address to Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 22 September 1948.

The Research and Development Board intended that its Program Guidance, Master Plan, and Consolidated Technical Estimates would help defense policymakers choose among competing weapon systems. The Weapons Systems Evaluation Group, operating under the joint supervision of the Joint Chiefs of Staff and the Research and Development Board, was another instrument for this purpose. Reacting to a recommendation from Bush for an organization that would employ some of the evaluative techniques drawn from the famous "operations research" experience of World War II, Forrestal established the Weapons Systems Evaluation Group in December 1948.[29] It was "to provide rigorous, unprejudiced, and independent analyses and evaluations of present and future weapons systems under probable future combat conditions. . . ." Headed by a senior military officer who was assisted by a civilian chief of research, the organization had a professional staff of about 50, half uniformed officers and half civilians, most of the latter full-time government employees but with some outside contractors and consultants. The Weapons Systems Evaluation Group spent most of 1949 recruiting staff and organizing. In September it received its first assignment—a study of strategic bombing's technical feasibility. Completed early in 1950, the study challenged the Air Force's contention that a strategic air offensive against the Soviet Union would be successful, and its contents were briefed to President Truman at the White House. The report did not resolve the controversy between the services over the efficacy of strategic bombing, but it did suggest the Weapons Systems Evaluation Group might become the objective and analytical instrument top officials needed to help make choices among weapon systems.[30]

Obstacles to Effectiveness

Several factors substantially reduced the Research and Development Board's effectiveness. Casting the longest and darkest shadow was its orientation. Rather than functioning as a staff agency to assist the secretary of defense in establishing research and development policy and coordinating programs, the board was largely an arena in which each service promoted its own interests, ever suspicious not only of the other military departments but also of the Office of the Secretary of Defense. Second, the military strategy formulated by the JCS was never fully integrated with the board's scientific and technical assessments. Third, the board's committee system, although unquestionably hamstrung by contests between the services, also contained inherent weaknesses of its own. Finally, information from the services about their research and development programs—the supporting data for board actions—was often unusable or overly optimistic.

In the late 1940s interservice rivalry, present to some degree throughout American military history, became especially sharp, even bitter. The services struggled fiercely to gain new functions ("roles and missions") or to preserve those they already possessed. As defense budgets shrank precipitously between World War II and the Korean War, and new weapons technologies (such as guided missiles) overlapped traditional land, sea, and air warfare boundaries, research and development became a key battleground. Success in developing a new weapon system promised long-term payoffs in the assignment of roles and missions and corresponding shares of the budget. In this environment, weapons development programs proliferated, but the Research and Development Board, structured along military department lines, was hard put to recommend that some be eliminated or combined with others. In an assessment of the board prepared for Secretary Forrestal in the fall of 1948, General Joseph T. McNarney, its senior Air Force member, pointed to the total of 35 different guided missiles of all types being developed by the services and the failure of the board's committees to confront such apparent duplication as "the most fundamental of all deficiencies now impeding the Board's progress. . . ." McNarney implied that clarification of service roles and missions might help overcome the difficulties associated with allocating responsibility for programs among the services.[31] (Despite two special meetings with the JCS that year—in March at Key West, Florida, and in August at Newport, Rhode Island—Forrestal had been unable to resolve entirely service conflicts over roles and missions.)[32]

Even had roles and missions been clarified, the representatives of the military departments on the Research and Development Board's committees would still have been partisan advocates of the narrow interests of their services. Robert F. Rinehart, who had served in the Office of Scientific Research and Development during World War II and was Hafstad's successor as the Research and Development Board's executive secretary, told Chairman Compton in March 1949: "Under present committee operations the military [department] members serve in a triple capacity of witnesses, attorneys for the defense, and judges with regard to research and development matters. In the first two capacities they are in many instances bound by the policies of their departments. Consequently in the role of judges they are not in a position to place weight on any evidence other than their own."[33]

One of the services—the Army—made a considerable effort to ensure that its officers and civilians serving either full time with the Research and Development Board or part time on its committees and panels knew exactly the position to take on matters that came before them. In June 1948, more than 200 Army personnel attended a meeting where Gordon Gray, assistant secretary of the Army, Lt. Gen. Henry S. Aurand, director of logistics on the Army staff, and Maj. Gen. Anthony C. McAuliffe, one of the Army's two Research and Development Board members, spoke positively of its work and of unification. Following these remarks, a briefing given by a colonel from the Army staff demonstrated the gathering's real purpose. Prior to attending Research and Development Board committee and panel meetings, the colonel declared, Army representatives should find out the department's viewpoint and "present a solid front on issues before the committee." Similarly, Army officers assigned to the board's secretariat were obligated to see that the Army's positions were considered in all of the board's work.[34] They, like officers from the other services posted to the board's permanent staff, also faced another pressure that discouraged the growth of a Department of Defense as opposed to a strictly service perspective—"fitness reports" (annual performance evaluations) were signed not by the officers' superiors in the Research and Development Board's secretariat but by senior officers from their respective services.[35]

Speakers at the mid-June 1948 meeting of the Army personnel associated with the Research and Development Board also expressed apprehension about its power to allocate responsibility for research and development programs among the services.[36] In theory, assigning one agency such responsibility would avoid unnecessary duplication and prevent waste. But the services feared that if one of them received primary responsibility for a program, it might ignore another service's interests. As Rinehart, the board's executive secretary, stated in his annual report for 1949, the departments "have not felt confident that under an assignment of responsibility the operational and technical rights and needs of a department of secondary interest would be properly protected through the mechanism of appeal to the Board."[37] There was little cause for concern. When it came to actually allocating responsibilities, the board's record, like that of its predecessor, was not impressive. By the end of August 1949, the Joint Research and Development Board and the Research and Development Board together had made but fifteen allocations, and these "were little more than [individual] projects and others merely approval of the programs already being conducted by the Departments."[38]

Interservice rivalry also affected the Research and Development Board's ability to fulfill the task it shared with the Joint Chiefs of Staff: to integrate research and development with military strategy. To achieve this objective, as early as October 1947, Forrestal had directed the Joint Chiefs to furnish the board with "general guidance on strategic concepts."[39] The JCS, however, did not do so because they were unable to agree on strategy among themselves. Late in February 1948, Forrestal informed President Truman: "We do not, at this time, have a definitely agreed-upon or carefully analyzed concept as to the character of a future war at a particular date, nor the kind of military establishment which we require as the best guarantee for preparedness against such an eventuality." The absence of a strategic concept, he said, "has limited all types of planning" and has been partly due to controversy between the Air Force and Navy over their respective roles in strategic bombing.[40] Finally in May 1948, the JCS came to terms on a short-range emergency war plan, code-named Halfmoon. Designed to respond to a Soviet invasion of Western Europe and the Middle East, the plan's concept envisioned an air offensive employing atomic bombs against strategic targets from bases in the United Kingdom, Okinawa, and the Cairo-Suez area.[41]

The JCS did not transmit the Halfmoon plan to the Research and Development Board. Instead, on 6 May 1948, the JCS forwarded a paper identifying only some of the general assumptions on which the plan was based.[42] Not only was the advice incomplete, but it was also late and not especially relevant. Earlier, on 31 March the board had requested comment by the JCS on an interim plan for research and development that it intended to send to the departments to assist in their budget planning until the first Master Plan could be completed. By late April, the JCS had not answered, so the board sent its interim plan directly to the services. On 6 May, the JCS paper on the Halfmoon plan finally reached the board, but it neither referred to the interim plan nor provided what the board wanted—an expression of JCS priorities for research and development.[43]

In August 1948, Hafstad, the board's executive secretary, told a committee of the commission appointed by President Truman and headed by former President Herbert Hoover to study the organization of the federal government's executive branch (the first Hoover Commission): "The JCS do not have an adequate idea as to what distribution [of R&D funds] is wanted. In other words, we don't know where we are going."[44] The next month, in his annual report, Hafstad said the Research and Development Board and the JCS had not created an effective way to exchange information, and "until adequate strategic guidance can be provided, the Board cannot make authoritative decisions regarding the priorities of projects and the distribution of research moneys between the military programs."[45]

On 9 September, now working on the Master Plan for Research and Development that it would publish in February 1949, the board once again asked the JCS for comments on the interim plan.[46] The JCS replied a week later but, without indicating why, stated that a critical period in the world situation would begin "after 1951." (This may have been a reference to the year after which the Soviets were expected to have an atomic bomb.) Because that time was not far off, the United States would "be forced to fight initially with a development of the weapons presently available." In the Joint Chiefs' view, research and development projects that would improve nuclear weapons and "provide for the most effective means for their application" should have the highest priority. The JCS assigned work on "truly advanced weapons" to the fifth of six priorities.[47] This, of course, confirmed the belief of many scientists that if the professional military determined priorities, radical new weapons would not be developed.

In November 1948, the Hoover Commission's Committee on the National Security Organization submitted a report critical of both the Research and Development Board and the Joint Chiefs of Staff. On the one hand, it stated, the board had failed to establish adequate relationships with the JCS and "has consequently been unable to bring the full influence of scientific advances to bear upon strategic plans or to insure that the military dollars going into research are bringing their full value in return." On the other hand, according to the committee report, the JCS had not supplied the Research and Development Board with "adequate" guidance.[48]

By the end of 1949, the Research and Development Board and the Joint Chiefs of Staff still had not established the kind of relationship necessary to join science and strategy. Julius Stratton, having recently completed his term as chairman of the board's Committee on Electronics, was particularly troubled by this failure. In February 1949, he wrote Compton that "[o]ur working groups can oil the machinery of research and development, and so contribute to the quiet whirling of wheels; but for all we know, the machines are turning out wheels for a company that plans to enter the hat business."[49] For one thing, integrating science and strategy, even had the scientists and the military been willing to pursue it together, would still have been enormously difficult: interservice rivalry and the uncertainties of rapidly changing technology would have been formidable hurdles to overcome. But for another, the JCS saw strategy formulation as the province of military professionals and excluded others from it. Neither Bush (nor Compton, as far as is known) ever attended a JCS meeting.[50]

In addition to the problems associated with interservice rivalry and a poor relationship with the Joint Chiefs of Staff, the Research and Development Board's effectiveness was also hampered by its committee structure. Its 16 committees faced a daunting prospect, reviewing as many as 18,000 service R&D projects.[51] As noted previously, the committees were plagued by interservice rivalry. Yet, even had the services not been pitted against each other, the manner in which the committees operated made achieving almost any task difficult.

Except for the small full-time professional staff that supported each committee, all committee members, whether from the departments or from outside the government, including the chairmen, served part time. On average, committees and panels met only five days a year.[52] The government representatives, continuously involved with the projects to be reviewed by the committees, easily overwhelmed the civilian outsiders even though the latter were expert in their fields.[53] One report described the typical committee dynamic:

> At meetings, the civilians [from the private sector] usually assume the role of jurists. The military [department] representatives play dual roles: first, as lawyers to argue for their cases, and then to sit with the judges to decide on the cases. Intentionally or otherwise, the civilians withdraw from [i.e., do not support] decisions contrary to the arguments of the military representatives. Most men trained in scientific and technical fields prefer not to argue against someone with fuller, more detailed information.[54]

The practical effect of their limited knowledge was that nongovernment civilian consultants were reluctant to dissent (any dissent had to be elevated to the board) and committees mostly "rubber-stamped" service programs.[55] Moreover, nongovernment specialists, aware that programs from different fields competed for limited funds, were not likely to be overly critical of money spent on projects in their own field, especially when the companies or academic institutions employing them held military research and development contracts.[56]

Other consequences of part-time membership were that the committees moved slowly and did not adapt easily to rapidly changing circumstances. In the fall of 1948, General McNarney informed the secretary of defense that committee action required two months or more. "This deficiency," he said, "is basic in any organization composed of part-time groups meeting only occasionally to discuss matters on a prepared agenda."[57] In early 1950, the board's Special Advisory Group, chaired by Robert E. Wilson, head of Standard Oil Company of Indiana, reported that at best committees required three months to complete a task and at worst up to six months.[58] The committees also lacked flexibility. In September 1949, Rinehart had told Compton that "a committee type organization was simply not equipped to answer some of the fire drill calls" [actions with short deadlines] coming from the secretary of defense.[59]

The inability of the committees to respond in a timely way caused the Research and Development Board's staff to seek alternatives. According to the Special Advisory Group, "some of the most important and urgent problems thrown to the Board have been handled outside of the established machinery, by improvised and informal techniques largely by-passing the mass of technical competence represented by the part-time agencies assembled in all areas by the Board." [60] When the board's staff acted without consulting the appropriate committee, hard feelings sometimes resulted.[61] Questions of "turf" or personality may have been involved, but the primary reason for this kind of activity was the secretariat's attempt to function as a traditional staff, serving not just the board but the secretary of defense as well.

The overlap of technical interests among the committees was also a persistent problem. It surfaced early. In the spring of 1948, Karl F. Kellerman, executive director of the Committee on Guided Missiles, wrote to Executive Secretary Hafstad that there was so much overlapping "it has led to the statement (not entirely in jest) by some of the military members [of the committees] that the only place where duplication exists is in the RDB."[62] The Guided Missiles Committee's panel on Warheads & Fuses, for example, covered "all types of warheads and fuses applicable to guided missiles" while the Ordnance Committee's panel on Ammunition and Explosives surveyed projects involving "warheads for guided missiles."[63] Donald A. Quarles, who replaced Stratton as chairman of the Committee on Electronics (and who would be assistant secretary of defense for research and development, secretary of the Air Force, and deputy secretary of defense), identified one of his committee's principal problems as determining boundaries with "such systems committees as Aeronautics, Guided Missiles, Ordnance, Navigation . . . to whom is assigned overall systems responsibility on subject matter that is in many cases largely electronics."[64]

The committees dealt with their wide-ranging and frequently overlapping technical interests by creating more panels, causing General McNarney to complain to Chairman Compton that the Air Force was hard-pressed to find enough representatives for them.[65] Compton replied that the board had begun to study the problem, and that joint panels, serving more than one committee, might be a solution. Compton warned, however, that some staff members opposed this approach because "the membership of such panels would not be sufficiently broad to cover the narrow interests of each of the several Committees involved."[66]

By the end of 1949, after two years in operation, the Research and Development Board had not yet overcome the difficulty presented by the overlapping interests of its committees.[67] At bottom, the problem was finding a way to organize and apply the specialized expertise of scientists and engineers to weapons whose subsystems were increasingly complex and interrelated and whose effective functioning also depended on their successful integration with other equally sophisticated weapons or ancillary support elements into a "weapon system." The board's committees may not have been well suited to this task, but, as subsequent chapters will demonstrate, neither were the established organizational structures in the services.

Without complete and accurate information about the services' research and development projects, including cost data, neither the Research and Development Board's committees nor the board itself could evaluate them. Obtaining suitable information from the services proved to be a major and enduring problem. The board's secretariat worked from the "project cards" (actually forms) that had been created by the Joint Research and Development Board for the services to report basic data on each R&D project. In 1948, the Research and Development Board received about 18,000 project cards; approximately 5,000 were completed, cancelled, or superseded during the year, leaving about 13,000 for the board to review and monitor.[68] The shortcomings of the cards generated widespread complaints and forced committee and panel members to seek additional information.[69] In the spring of 1949, a special report prepared for Compton revealed that some 3,500 cards did not list funds, more than 2,000 did not identify the contractor, and about 700 omitted both. "Some cards," wrote the study's author, "describe vast undertakings involving many supporting researches and costing many millions of dollars, while others suggest vague ideas or aspirations, and others describe expenditures of money and effort in the most trivial details of procurement or acceptance tests (for example, the most satisfactory brass polish)."[70]

An especially vexing irritant affecting the Research and Development Board's ability to evaluate projects was that the services did not have uniform financial accounting systems and reported R&D costs differently. This made it almost impossible to compare how much was actually being spent on similar projects.[71] The Air Force, for example, was the only service to include expenditures for overhead (indirect costs such as maintaining R&D facilities) in its totals.[72] Indirect costs were substantial, amounting to an estimated 10 to 20 percent of the services' research and development programs.[73] Compton thought cost-accounting differences among the services sufficiently important to mention them in his farewell letter to President Truman when he resigned the board chairmanship in November 1949.[74] Lack of uniformity in this area would continue to hinder efforts to rationalize defense budgeting for years to come.

The Budget, the Board, and Service Programs

Funds appropriated for research and development were a relatively small portion of the annual military budget. In fiscal years 1949 and 1950, they averaged $620 million, roughly 4½ percent of the approximately $13.75 billion budget average for each of those two years.[75] Even so, the services fought hard to obtain the largest possible slice of the research and development appropriation. Adding advanced weapons to a service's arsenal potentially meant the assignment of new or expanded roles and missions and a bigger share of the budget.

During the Truman administration, the White House established a ceiling at the beginning of the budget cycle on the amount of funds it intended to request from Congress for the Defense Department. Under the National Security Act, the secretary of defense was responsible for preparing the department's budget. He did so within the guideline determined by the president. The services invariably requested more than was allowed by the ceiling. For the FY 1950 budget (the first integrated Department of Defense budget), for example, the department's request was not to exceed $14.4 billion. The services together, however, initially proposed more than twice that figure, $29 billion.[76] Thus the secretary of defense, working through the JCS, was left with the very difficult task of trimming the military departments' requests to fit within the White House's mandate.

The research and development portion of the total budget was also subject to a ceiling, but one determined by the secretary of defense, not the White House. Based on the advice of the Research and Development Board and the departments, the secretary decided this amount and assigned a percentage of that figure to each department. For the FY 1950 budget planning cycle that began early in 1948, Forrestal set the R&D ceiling at $550 million, which accorded with the recommendation made by RDB Chairman Bush but fell well short of the $1.3 billion initially requested by the services.[77] Louis Johnson, who succeeded Forrestal in March 1949 and, like him, was intent on reducing the budget, set the R&D ceiling for FY 1951 at $500 million and that for FY 1952 at $510 million.[78]

The secretary of defense's decision regarding each service's share of the R&D funding request was arbitrary. For each of the three fiscal years 1950–1952, OSD allocated approximately 20 percent to the Army, 40 percent to the Navy, and 40 percent to the Air Force, with the distribution based on nothing more substantial than that those had been the shares for FY 1949.[79] But the fault was less OSD's than the RDB's, which had not provided the secretary of defense with a more rational way to assign the percentage. When the FY 1950 planning figure was being decided in the summer of 1948, Bush told Forrestal: "At the present time . . . a sound basis for advocating such a shift [i.e., from the FY 1949 distribution] is not present."[80] In March 1949, after reviewing the departments' programs based on the FY 1950 planning ceiling, Forrestal suggested that the board establish a priority listing of all the individual projects "without regard to the resulting distribution of funds between the Services."[81]

By the end of 1949, however, the board still had not come up with a way to divide R&D funds between the Army, Navy, and Air Force.[82]

Although the secretary of defense determined how much would be spent on research and development (and at least for FY 1950, his decision was heavily influenced by the recommendation of the Research and Development Board's chairman), neither the secretary nor the board exercised much control over the content of the services' R&D programs. When they were submitted to the board in accord with the monetary limits set by OSD, the programs had already been approved by the services. Few changes, for reasons previously described, ever took place during review by the board's committees. In mid-1949, Ralph L. Clark, former executive director of the Committee on Electronics, wrote Compton: "The programs prepared in support of the F. Y. 1951 budget, by the Departments, are completely Departmental programs. The committees approved them substantially as submitted. . . ."[83] About the same time, Maj. Gen. Everett S. Hughes, chief of Army ordnance, reportedly told the board's Ordnance Committee that its "action on the FY 51 budget was not of much importance anyway because the [Army ordnance portion] was actually prepared in his office, implying that what he put in was what really stayed in the budget."[84] Worse yet, the service programs as submitted sometimes blatantly ignored recommendations in the Research and Development Board's Program Guidance and Master Plan. "It was obvious to all Committee members," wrote the chairman of the Committee on Human Resources in June 1949, "that the Air Force FY 1951 budget is the only one showing any noticeable influence of RDB strategic or program guidance. The Army and Navy budgets are not only inadequate in general but are distributed improperly."[85]

Eliciting the voluntary cooperation of the departments was not enough to bring about shifts in emphasis in service research and development programs. Bush recognized this early, telling Forrestal that funds controlled by the secretary of defense and not earmarked for a particular service would ultimately be needed to strengthen OSD's influence over military research and development programs.[86] Secretary of Defense Johnson also acknowledged that OSD must directly control some R&D funds. Prior to establishing the research and development planning ceiling for FY 1952 early in 1950, Johnson informed Rinehart, then the acting Research and Development Board chairman, that he intended to withhold a percentage of the total R&D figure "in order that the Board may achieve the shifts of emphasis required to produce the soundest over-all program for the department of defense."[87] When he established the ceiling at $510 million a few weeks later, $25 million of the total was placed in a "Secretary of Defense Reserve."[88] OSD, however, did not intend to initiate its own projects. Instead, it would provide money from the reserve fund to a service for work that the board thought required increased support. Setting aside a portion of the R&D budget for this purpose was a small but significant step toward developing an OSD, as opposed to a strictly service, program for research and development.


Louis A. Johnson, secretary of defense, 1949–1950.

Some wanted to go further. Rinehart, in his 1949 annual report, had recommended that the Research and Development Board and Munitions Board chairmen jointly administer a $10 million fund to sponsor research in developing substitutes for some strategic materials.[89] After reviewing the draft report of the Research and Development Board's Special Advisory Group, Lee A. DuBridge, president of the California Institute of Technology, also suggested that the board direct its own research program. "I have a feeling," he wrote Robert Wilson, the Special Advisory Group's chairman, "that some consideration should be given as to the desirability of gradually making RDB an operating organization. I know there are disadvantages in this, but there are some advantages in RDB having funds at its own disposal for setting up and directing research enterprises which seem not to fall within the purview of the Services or which are of interest to all of the Services."[90] The military departments, jealous of their prerogatives in this area, would have strongly objected to having the board assume such a role. Indeed, in 1949 the Hoover Commission's Committee on the National Security Organization had opposed giving the Research and Development Board money of its own to finance basic research: "Such a grant of funds would . . . make the Board, now a coordinating and policymaking agency, an operating one, with all the disadvantages of the possible overlap, friction, and administrative problems that might ensue. It would, moreover, put the Board in the position of encroaching, not only upon the proper operational role of the individual services but also upon the role of the projected National Science Foundation."[91] The time for OSD to be an "operating organization" with its own research and development program was still years away, authorized for the first time only with the creation of the Defense Department's Advanced Research Projects Agency by Congress early in 1958.[92]

Criticism of the Research and Development Board

By the end of 1949, after two years of operation, the Research and Development Board appeared to some to be foundering. Compton had resigned in November, and the board was without a permanent chairman until March 1950. Hanson Baldwin, military correspondent for the *New York Times*, wrote early in 1950 that "[o]verlapping and duplication, and a rather loose administration have caused the board to lose, in past months, the once fairly high reputation it enjoyed in the Department of Defense."[93] Among the board's staff members, criticism was even harsher. Some were discouraged that the services seemed to ignore board or committee recommendations.[94] Others believed that the committees had become bogged down in detailed examination of individual projects associated with the R&D budget instead of tackling major policy issues, thereby wasting the talents of many highly qualified part-time expert consultants. Reflecting the views of many who served the Research and Development Board, former electronics committee chairman Julius Stratton, in February 1949, put it bluntly: "This Board and its committees should be mainly concerned with policy and planning. Instead it has, in my opinion, given too much attention to policing of programs in detail. This policing is undertaken with a commendable desire to eliminate waste, but I have begun to believe that the fear of duplication in research and development shows signs of becoming a dangerous obsession." He further asserted that part of the price of failing to launch "a concerted attack upon major objectives" would be the disillusionment and ultimate loss of experts from industry and the universities.[95] Compton echoed this view in his resignation letter to Truman, saying that the part-time consultants could not be retained "if swamped with details and 'policing' functions."[96]

Acting Chairman Rinehart, in the 1949 annual report, pointed out some of the board's achievements, such as publication of the Master Plan, but also candidly admitted its numerous problems. He explained that the board was divided between proponents of giving "broad general" guidance to the departments and advocates of providing "detailed" advice on specific parts of research and development programs. Rinehart counted on a pending reorganization and the leadership of a new chairman to establish "the basic philosophy and procedures under which the RDB is to operate."[97] The Special Advisory Group's report, submitted formally at the end of February 1950, acknowledged that some of the criticism of the board was "well-founded" and recommended several changes including the appointment of a deputy chairman. Although a "re-interpretation of the tasks and operating philosophy" of the committees and panels was needed, a "drastic reorganization" of their structure was not required. The "real root of the matter," observed the group, was that the board "must confine its principal efforts to questions of policy and to issues of basic importance for the future conduct of research and development in the Department of Defense."[98]

Resolution of the debate over the board's operating philosophy and plans for its reorganization, however, would have to wait. In January 1950, Secretary Johnson directed that changes be "held in abeyance" until a new chairman was appointed.[99] As a result of the additional power given to the secretary of defense by amendments to the National Security Act in August 1949, the new chairman would enjoy enhanced power. He would be able to decide matters before the board in cases of any service split; previously he could carry the day only when he sided with two of the services against the third.[100] On 15 March 1950, William Webster, vice president of the New England Electric System and former chairman of the Research and Development Board's Committee on Atomic Energy, became the board's new chairman. Overcoming the organization's many problems would be a challenge of the first order.

COORDINATION OF PROCUREMENT PRIOR TO THE NATIONAL SECURITY ACT

While the benefits of coordination in research and development were expected to be both integration and economy, in coordinated procurement the emphasis was almost entirely on economy. In the 1940s, procurement encompassed a wide variety of purchase (contracting), production, and distribution (supply) functions. According to one contemporary authority, these included:

> . . . the computation of materiel requirements and the operation of a supply control system and all phases of purchase, including contract forms, contract placement, contract appeals and modifications, pricing, renegotiation, and termination . . . the administration of patents, the scheduling of contracts and financing of production . . . such matters as specifications; conservation; industrial facilities; including plants, tools, and equipment; the scheduling and expediting of production; the utilization and training of industrial manpower; the inspection, packaging, crating, and transportation of finished munitions; and their distribution, storage, and issue to the using services.[101]

During World War II, the Army and Navy voluntarily coordinated their activities in some of these areas, and this cooperation continued into the postwar period.

The war's urgent demand for materiel had caused intense and counter-productive competition between the services. In August 1944, then Senator Harry Truman (D-Mo.) head of the Senate's Special Committee to Investigate the National Defense Program and also a vice presidential candidate, labeled the procurement record "a dreary succession of wastes, duplications, and ugly conflict."[102] In an attempt to reduce this competition and to satisfy their materiel requirements, the services employed a series of jointly staffed procurement boards, agencies, and committees. Among them were the prewar Army-Navy Munitions Board and the Aeronautical Board, and such wartime creations as the Army-Navy Communications Board (for electronic equipment), the Army-Navy Petroleum Board, the Central Procurement Agency of Lumber, and several procurement-related committees. Aircraft procurement for the Army Air Forces and Navy was especially well-coordinated, amounting to as much as 90 percent of the total program, through a number of joint bodies: the Aeronautical Board, the Joint Aircraft Committee, the Aircraft Scheduling Unit, and the Aircraft Production Board. The services also formally agreed on some contract policies and procedures, particularly on contract termination and renegotiation regulations. Additionally, they often worked together informally on procurement matters, as illustrated by the close relationship between the Navy's chief of the Bureau of Ordnance and the Army's chief of ordnance. In a few instances, known as "cross-procurement," one service purchased most or all of the other service's requirements for a particular commodity or item. The Army's quartermaster general, for example, bought 90 percent of the Navy's perishable and 85 percent of its nonperishable foods.[103]

Early in 1945, a report prepared for the secretaries of war and Navy surveyed the extent of the services' cooperation in procurement. Its authors, Army Col. William H. Draper (later under secretary of the Army) and Navy Capt. Lewis L. Strauss (later chairman of the Atomic Energy Commission), noted long-standing congressional interest in the subject and concluded that despite the progress made during the war, coordination was often "inadequate." With respect to both procurement policies and activities, more interservice coordination was "definitely needed." For Draper and Strauss, the answer was not more joint boards and committees, each with responsibility for a single aspect of procurement. They felt that these types of coordinating mechanisms would inevitably develop overlapping interests and, operating independently, would likely develop conflicting policies.[104]

Instead, to bring about expanded and effective interservice coordination, Draper and Strauss recommended the creation of a joint staff organization at the departmental level that would function in procurement roughly as the Joint Chiefs of Staff operated in strategy. The proposed "Joint Materiel Chiefs" would be headed by two of each service's highest-ranking logistics officers under the supervision of the under secretary of war and the assistant secretary of the Navy. Supported by a staff run by a joint director of materiel, the Joint Materiel Chiefs would formulate policy and coordinate service activities across much of the procurement spectrum.[105] Although Draper's and Strauss' proposal was not implemented, their favorable assessment of interservice procurement led, ironically, to more joint boards and committees, namely the Army-Navy Joint Specifications Board, the Army-Navy Medical Purchasing Office, the Joint Army-Navy Packaging Board, and the Joint Army-Navy Petroleum Purchase Agency.[106]

In keeping with the movement for defense unification and the clear trend toward more cooperation in procurement, President Truman approved a charter for a reconstituted Army-Navy Munitions Board in August 1945. Originally established in 1922 and responsible for developing mobilization plans in the interwar period, the joint board had been eclipsed by other agencies during World War II and left with little to do. The postwar board was headed by a civilian executive chairman appointed by the under secretary of war and the assistant secretary of the Navy with a flag officer (general or admiral) from each service serving as deputy chairmen. Unlike the Joint Research and Development Board with its civilian "outsiders," the Army-Navy Munitions Board was entirely "insiders"—its professional staff was made up of uniformed officers and civil servants from the two departments. In the fall of 1946, an amendment to the board's charter enhanced the executive chairman's power by enabling him to make the final decision in disputes between the services over allocation of responsibility for procurement of common-use commodities or types of equipment.[107]

The Army-Navy Munitions Board's principal duties were to prepare a national industrial mobilization plan and to accumulate and administer the stockpile of "strategic and critical materials" mandated by Congress. But it was also charged with furthering coordinated procurement between the War and Navy Departments and with asserting policy control over the numerous joint procurement boards, agencies, and committees that had continued into the postwar period, such as the Joint Army-Navy Petroleum Purchase Agency and the Joint Army-Navy Specifications Board.[108]

Building on the precedent established during the war, the Army-Navy Munitions Board worked deliberately, albeit quite slowly, to advance coordinated procurement by assigning purchase authority for common-use materials. Committees of representatives from each department studied commodity areas and recommended those suitable for allocation. By the time the Munitions Board succeeded it in the fall of 1947, the Army-Navy Munitions Board had allocated sole purchase responsibility only for solid fuels (Navy), lumber (Army), and athletic and recreation equipment (Army), and had divided purchase authority between the services only for ordnance and ammunition; for construction, mining, and excavation equipment; and for marine life-saving gear. One reason for this apparently meager record was that the various cataloging systems employed by the Army's technical services and the Navy's material bureaus resulted in "the confusion of similar items being listed under different classes of materials."[109] To eliminate this fundamental difficulty, the Army-Navy Munitions Board established a "Cataloging Agency" in July 1947 to work toward a uniform classification system.[110] At the time undoubtedly few, if any, recognized that this would take more than a decade to accomplish.

Armed Services Procurement Act of 1947

A major obstacle to increasing coordinated procurement was that the services frequently followed different purchasing rules. "Placing the War and Navy Departments under the same basic procurement statute," stated Assistant Secretary of the Navy W. John Kenney in February 1947, "would eliminate many differences in their present statutory authority which complicate the coordination of procurement between the services."[111] Kenney was then testifying before a subcommittee of the House Committee on Armed Services to support legislation (H.R. 1366) originating from a 1945 report of the Procurement Policy Board, an interagency body with representatives from the War and Navy Departments. H.R. 1366 reflected the report's recommendations, but would not become law for another year.[112] Although more coordination was certainly desirable and would likely be facilitated by the legislation, the proposed law's purposes were much broader and of great significance for postwar defense acquisition.

World War II had prompted radical changes in the military's contracting procedures, giving the services nearly unlimited flexibility in buying equipment and other materiel. Instead of the traditional—and slow—system of advertising, competitive bidding, and fixed-price contracts, the government used negotiated, cost-plus-fixed-fee and other contract forms, as an alternative. The government also disbursed advance, progress, and partial payments to contractors and assumed much of the cost of new plants and equipment. These changes had been effected under the president's temporary wartime powers. In 1947, the War and Navy Departments proposed to make the practices permanent.[113]

The resulting legislation, the Armed Services Procurement Act (P.L. 413), became law early in 1948. It provided the uniformity and flexibility in acquisition that many were convinced were essential for both "economy and national security."[114] While mandating advertising and competitive bidding as the standard contracting procedures, the act also listed seventeen exceptions, some previously authorized by statute and others entirely new. The major result of employing these exceptions was that negotiated sole-source contracts became the most commonly used contracting method.[115]

Several of the exceptions permitting negotiated contracts clearly illustrated how the demands of highly technological warfare and the need to develop and to produce advanced weapons affected acquisition. Two exceptions dealt with research and development. One excepted work performed for the government by educational institutions; the other provided that advertising need not be used if the agency head determined that the required work involved "experimentation, development, research, and test."[116] Late in 1948, Assistant Secretary of the Navy Mark E. Andrews, who had spearheaded the Navy's part in drawing up the legislation, explained to students and faculty at the Industrial College of the Armed Forces why these exceptions were significant:

> We . . . wanted to have a permanent statute that would make it possible to buy ideas . . . Well, there is a long time and [a] lot of work involved between that idea and the finished equipment. And sometimes the finished equipment doesn't look anything at all like the artist's picture of how it would look if it could be drawn at the time it was an "idea." You can see how it would be very difficult, if not impossible, for manufacturers to bid competitively on the production of an idea—a jet engine, for instance, or a new type of computer, or a new piece of electronic equipment. We do that under this act by drawing up, not a set of specifications, but a set of hopeful accomplishments. We talk to people in industry and, quite frequently, to people in the educational field—a professor of physics at MIT, or a professor of electrical engineering at The California Institute of Technology—about the solution of this problem. Instead of having a competitive-bid procedure, we make a deal with the institution to work out the solution of this idea to put it on paper, at least. Then,

> after we progress that far, we may make one or two prototypes. The first prototype and the second prototype often aren't even recognizable [when compared to the finished product]. But finally, through this process of a thought, or an imaginative flash, a discussion with a man most outstanding in that field, some lines on a piece of paper, one or two prototypes, a few production models, we come out, for example, with a proximity fuse. We could not possibly have bought the proximity fuse, and I doubt if we could have obtained the proximity fuse, if we had had to start out on a competitive-bid basis with no other means of making a business deal.[117]

In the kind of development process Andrews described, costs were unpredictable. Thus, the authority that the act granted to deviate from the standard fixed-price contract and to employ some form of cost-reimbursement contract was especially important.[118]

Some of the exceptions to the formal advertising procedure concerned production. The act made it possible, for instance, to use negotiated contracts for "technical equipment" that required standard specifications and interchangeable parts. In the hearings, Kenney cited the jeep, originally developed by the American Bantam Car Company but mass-produced by Willys-Overland and Ford during World War II, as an illustration of how a negotiated contract had furthered the objectives of standardization and interchangeability. "Unquestionably," he testified, "other automotive manufacturers could have developed another motor vehicle capable of meeting the performance specifications laid down for the jeep. It was, however, obviously desirable to have only one vehicle standardized for use throughout the world, to increase efficiency and to avoid the necessity for increasing spare parts inventories." Once an equipment item had been initially procured, purchases of additional units or spare parts could be negotiated with the original manufacturer. Through this means the government could obtain the standardization and interchangeability it sought, although possibly incurring higher prices for any additional units or replacement parts not separately priced in the original contract.[119]

Another exception to formal advertising authorized by the act reflected the increasing complexity of advanced weapons and the time needed to develop them. In such circumstances, negotiated contracts could be used "for supplies of a technical or specialized nature requiring a substantial initial investment or an extended period of preparation for manufacture. . . ."[120] Here the central issue was quality—the military service's ability to acquire the item it desired from the best-qualified manufacturer. "Where quality is a matter of critical—in many cases life and death—importance," stated Kenney, "discretion must reside in the services to select sources whose experience, expertness, know-how, facilities, and capacities are believed to assure products of the requisite quality."[121]

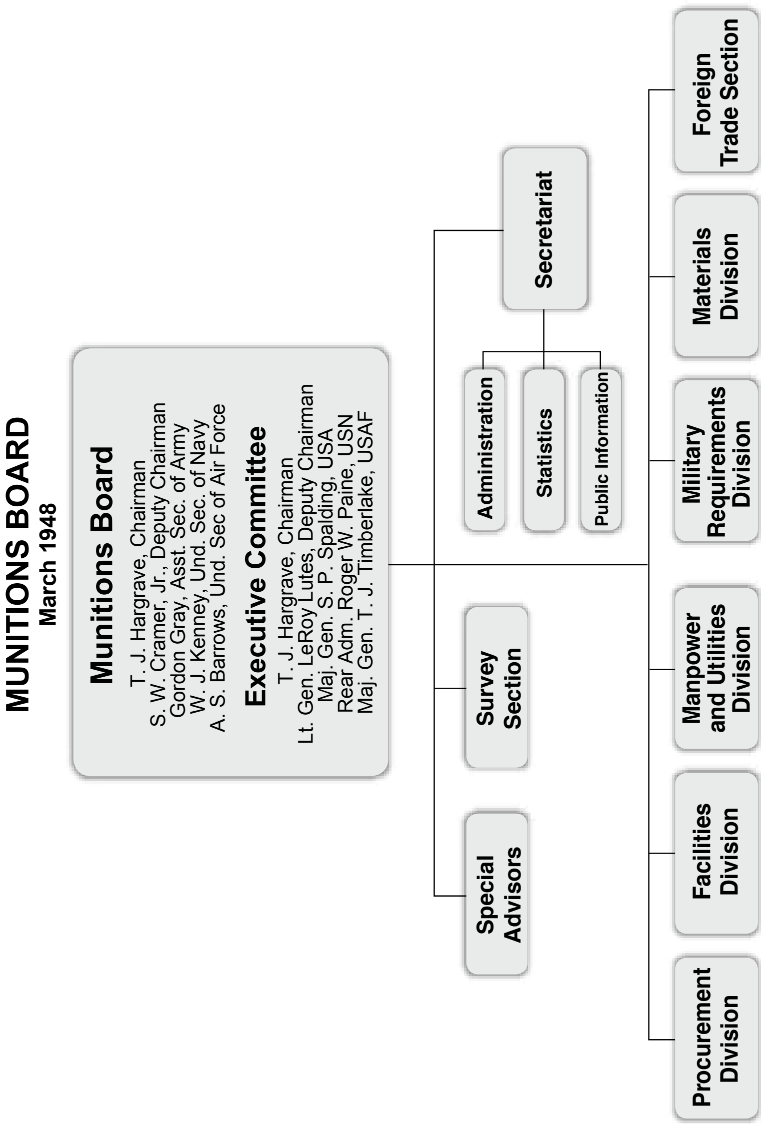
To help ensure that the nation would be able to mobilize its resources as rapidly as possible in a future emergency, the act also permitted negotiated contracts designed to maintain or develop certain materiel capabilities. Known as "educational orders," such contracts had been allowed as an exception to advertising as early as 1936. Their authorization in the Armed Services Procurement Act of 1947 reflected the commitment to preparedness shared by American leaders in the postwar period.[122]

President Truman signed the Armed Services Procurement Act on 19 February 1948. Writing to the secretary of defense, he pointed out that the unprecedented procurement flexibility the act allowed in peacetime imposed corresponding responsibilities on the National Military Establishment. One was to ensure that the government obtained "favorable price and adequate service." Another was the obligation, as mandated by the act, to see that small businesses received "a fair proportion" of military procurement. This requirement reflected the use of contracts to further economic or social goals that, from the perspective of defense officials, were not necessarily related to achieving military objectives. In his letter, the president asked the secretary of defense to "specify detailed standards" for carrying out the small business and other provisions of the act. In fact, the services, under the policy supervision of the Munitions Board, which succeeded the Army-Navy Munitions Board in September 1947, had already been at work drawing up uniform implementing procedures. The initial edition was published as the Armed Services Procurement Regulation in May 1948.[123]

THE MUNITIONS BOARD

Organization and Functions

The Munitions Board chairman, like his counterpart on the Research and Development Board, was a civilian appointed by the president. Thomas J. Hargrave, chairman of the Army-Navy Munitions Board since 1 July 1947, continued in the same position on the new board. Also, like Vannevar Bush, he served only part time, returning to Rochester, New York, about every other week to attend to his corporate responsibilities as president of Eastman Kodak.[124] Hargrave stayed on as chairman only about a year and was succeeded by Donald F. Carpenter, a vice president of the Remington Arms Company and outgoing chairman of the Military Liaison Committee (the Atomic Energy Commission's military advisory body). Although he served full time, Carpenter agreed to stay only temporarily and left at the end of June 1949. The four-member board was then without a permanent chairman until late November when Hubert E. Howard, a coal company official, was appointed. The other three members of the board were also civilians—by law either an under or assistant secretary from each of the military departments. Initially, an executive committee made up of the board's chairman, a deputy, and a flag officer from each service managed the organization's day-to-day business.[125]



Source: Adapted from Chart 5 (Munitions Board), in Rearden, *The Formative Years 1947–1950*, 93.

Munitions Board, December 1948. Seated, left to right: Gordon Gray, assistant secretary of the Army; W. John Kenney, under secretary of the Navy; Donald F. Carpenter, chairman of the board; Arthur S. Barrows, under secretary of the Air Force. Standing, left to right: Maj. Gen. P. W. Timberlake, USAF, military director; Lt. Gen. LeRoy Lutes, USA, director of the staff; Rear Adm. F. C. Denebrink, USN, military director; Maj. Gen. S. P. Spalding, USA, military director.

In January 1948, Secretary of Defense Forrestal chose Lt. Gen. LeRoy Lutes to be the executive committee's deputy chairman. Forrestal explained to Truman that the Lutes appointment was noteworthy because he hoped to fill the post with officers highly experienced in logistics, who were near the end of their careers, and "who no longer are affected by the intangible compulsions of ties to a particular service." Lutes, deputy commanding general of the Army Service Forces during World War II and most recently director of the Service, Supply, and Procurement Division at Army headquarters, met these requirements. According to Forrestal, the general would be his "link" to the board and a personal adviser on logistics. But when Forrestal finally issued the Munitions Board's implementing directive in June 1948, the executive committee arrangement was abandoned. Instead, Lutes assumed the duties of the newly created position of director of the Munitions Board staff. The three flag officers, formerly on the executive committee, became heads of subordinate elements in the organization.[126]

Lieutenant General LeRoy Lutes
Courtesy, U.S. Army Center of Military History.

Lieutenant General LeRoy Lutes (1890–1980)

Many American leaders believed that the ability of the armed forces to plan and execute genuinely unified military operations would be a key ingredient of postwar national security. In a November 1947 lecture at the Industrial College of the Armed Forces, Vannevar Bush, chairman of the newly established Research and Development Board, argued that such unified effort could not be achieved through reorganization of the military establishment alone. Unification and coordination, Bush explained, required military officers "capable of rising above" their service loyalties to engage in planning "without distortion due to personal experience, attachment, or prejudice." Army Lt. Gen. LeRoy Lutes, appointed deputy chairman of the executive committee of the Munitions Board by Secretary of Defense James Forrestal on 5 January 1948, was one of those exceptional officers capable of working without prejudice in the service of larger national goals.

Born in Cairo, Illinois, in 1890, Lutes enlisted in the National Guard in 1906, graduated from Wentworth Military Academy in 1908, was commissioned in 1914, and accepted an appointment as a second lieutenant of Infantry in the regular Army three years later. During the interwar years, he served in a wide variety of assignments and graduated from the Command and General Staff School and the Army War College.

Lutes gained recognition for his superior logistical skills during World War II. In March 1942, then Colonel Lutes was named director of operations for the Army's newly organized Services of Supply (later Army Service Forces) where he worked actively to improve coordination among the services. When given responsibility for ameliorating severe supply problems in the South and Southwestern Pacific areas of operation, Lutes recommended unification of Army and Navy supply lines. Despite stiff resistance from both services, his ideas on interservice cooperation proved influential. The services established the Army-Navy Logistical Board for the South Pacific in 1942, and soon thereafter agreed to a Basic Logistical Plan that called for the creation of unified plans and joint priority lists.

Lutes rose rapidly in the Army Service Forces, becoming a major general and the organization's deputy commander before the end of the war, and its commander in January 1946. Following the Army reorganization of that year and the dissolution of the Army Service Forces, Lieutenant General Lutes became the director of the Service, Supply, and Procurement Division on the War Department General Staff. By the time he was appointed to the Munitions Board staff early in 1948, he was widely recognized as a "cool and efficient" troubleshooter capable of overcoming bureaucratic barriers and managing conflicting personalities.

As its director, Lutes sought to make the Munitions Board staff an effective agency serving the secretary of defense. But with opposition from the services and weak support from Secretary Forrestal, Lutes was unable to realize this goal. Still, under his leadership, the Munitions Board staff provided uniformed officers and civilians from all the services with experience working together and exposure not only to the problems but also to the possibilities of unification.[11]

When Lutes came to the Munitions Board early in 1948, its staff was small, only 130 full-time members. Of these, 27 were military officers and 20 civil service professionals; the remaining 83 were civilian clerks and other support personnel.[127] From then on the staff grew steadily; within six months it numbered 295, with 64 military personnel and 231 civilians. The Hoover Commission's Committee on the National Security Organization pointed out, however, that although there were more civilians than military on the staff, the civilian total included "clerical and service personnel of relatively minor rank," and despite the "substantial number" of high-grade civilian positions, "the military predominate in all policy positions on the Board's staff."[128] By early 1950, the staff had more than doubled in size to 697. Of this total, 132 were military personnel and, despite the recommendation of the Committee on National Security Organization to secure more civilians to guide the board's planning and operations, military officers continued to dominate the staff.[129]

In March 1950, a report on the board's internal organization, prepared for the secretary of defense's Management Committee, revealed the uniformed military's near monopoly of key staff positions. Military officers held 49 (or 82 percent) of the 60 top posts below the director of staff. Furthermore, according to the report, civilians occupying the remaining 11 slots "participate very little in the planning and direction of the activities of the Munitions Board staff." At the same time, turnover among the military had been rapid (32 officers had circulated through the 14 top-level posts since mid-1949). "Obviously," concluded the report, "planning, direction, and guidance of Munitions Board activities must suffer under these circumstances."[130]

The report for the Management Committee and an earlier anonymous study (most likely prepared by a civilian on the Munitions Board staff) suggested that officers assigned to the board were not always qualified. The official report stated that efforts to obtain qualified officers "have not always been successful."[131] The anonymous paper was more direct: "The military departments have not assigned their better men to the Board. They, for the most part, have been men in need of an assignment. . . . The fact that these individuals are placed in charge of activities which have serious economic and industrial implications, and direct the activities of highly qualified technical and professional workers, aggravates misdirection in the conduct of the Board's programs."[132] The rationale for accepting unqualified officers on the board's staff, wrote the author of the Management Committee study, was based on "the apparent theory that because he is an officer he automatically is capable of meeting the responsibilities of the position to be filled."[133] The statement may have reflected the resentment among some Defense Department civilians over the preference given uniformed officers for top management jobs. In October 1949, the secretary of defense had acted to correct the situation by making it department policy that civilians were to fill "all positions which do not require military skills or military incumbents for reasons of training, security or discipline."[134] In keeping with that policy, the Management Committee report recommended that a much greater effort—there had been "practically no effort" to that point—be made to recruit and assign qualified civilians to key positions on the Munitions Board staff.[135]

The staff was only one element of the complex Munitions Board structure. Supported by the staff, the board carried out its responsibilities through a collection of interservice boards, agencies, councils, committees, and subcommittees that defies simple description. Much of this structure predated the National Security Act. Indeed, at the outset, the Munitions Board was essentially the Army-Navy Munitions Board (including the latter's internal organization and many of its personnel) with a shorter name. Some of the pre-July 1947 interservice carryovers were the Aeronautical Board and the Armed Services Petroleum Board. Other elements of the Munitions Board, such as the Aircraft Committee and the Procurement Policy Council, were established after the National Security Act went into effect. Although the board exercised policy supervision over most of these organizations, they did not report through the board's staff but directly to the board. Furthermore, Munitions Board staff members usually did not chair these bodies and sometimes were not even members.[136] The Procurement Policy Council, for example, was made up of high-ranking uniformed officers from each department who alternated as its chairman. The council's job was to coordinate the work of all Munitions Board bodies involved in procurement such as the joint cataloging, standards, and material inspection agencies, and several purchase assignment committees.[137]

In addition to the variety of interservice bodies, the board was assisted by a large number of industry advisory committees. With members drawn from the private sector, these committees were most often organized by particular industrial material or end product such as the Iron and Steel Industry Advisory Committee or the Machine Tool Industry Advisory Committee. Their primary purpose was to support the military's materiel mobilization planning.[138] In mid-1948, there were 14 industry advisory committees with 400 members; in mid-1949, 23 committees and 600 members; and by June 1950, 26 committees with 800 members.[139] Normally, advisory committee members were company board chairmen, presidents, or vice presidents, and the committee rosters amounted to a *Who's Who* of American business and industry in the late 1940s. For example, in 1948, the 23 members of the Iron and Steel Advisory Committee included the presidents of Bethlehem Steel, Henry J. Kaiser Co., Inland Steel, Jones & Laughlin Steel, Republic Steel, Youngstown Sheet and Tube Co., and U.S. Steel.[140] The industry advisory committees, however, were not analogous to the Research and Development Board's committees. They met perhaps once or twice a year and were not directly involved in Munitions Board operations.[141] Nonetheless, like the private-sector scientists and engineers who served on Research and Development Board committees and conceived the means of war, the prominent businessmen and industrialists who served on Munitions Board advisory committees and manufactured those means also developed ties to officials at the highest level of the military establishment.

In the nearly two years that he was assigned to the Munitions Board, Lieutenant General Lutes tried hard but failed to turn it into an effective staff agency of the secretary of defense rather than merely an assembly of organizational entities that represented the interests of the military departments. In separate memorandums for the secretary of defense and the incoming Munitions Board chairman, written on the eve of his departure in October 1949, Lutes explained that the objective had not been realized because, in his view, the secretary of defense and Munitions Board chairmen had not exercised the necessary leadership. "It should be made clear," he told Secretary Johnson diplomatically, "that the Munitions Board is a staff agency of the Secretary of Defense and not an interdepartmental committee."[142] In the memo he left for the new Munitions Board chairman, Lutes was more direct: "[T]he members of the Munitions Board have considered themselves to be representatives of their Departments rather than members of a staff agency of the Secretary of Defense. The attitude of the Board members was at times reflected in their representatives on the Munitions Board staff and vice versa." He also told the incoming chairman that the secretary of defense had not supported him to the extent required and the two preceding Munitions Board chairmen had been "reluctant to make decisions and reluctant to have the Secretary of Defense give them full power of decision."[143]

As director of the Munitions Board staff, Lutes leaned much more toward unification than Secretaries of Defense Forrestal and Johnson, or Hargrave and Carpenter as chairmen, were willing to go.[144] In June 1948, Forrestal had not issued as strong a governing directive for the board as Lutes had wanted.[145] Furthermore, in revising that directive in November 1949 in response to the National Security Act amendments, Johnson had not taken the opportunity to expand the Munitions Board chairman's decision making authority.

Despite Lutes' frustration, in the course of several reorganizations the Munitions Board made some progress toward the greater centralization that he wanted. By the time he left in the fall of 1949, some bodies that previously reported directly to the board had begun to report to the board through its staff. For example, the cataloging, standards, and material inspection agencies had been transferred from the direction of the Procurement Policy Council to the supervision of the Munitions Board staff. Additionally, the Armed Services Petroleum Board was moved from the Joint Chiefs of Staff's organization to the Munitions Board, reconstituted as the Petroleum Committee, and placed under one of the board's staff elements.[146] Nonetheless, according to the Management Committee's early 1950 study, each attempt to make the board an effective staff agency through reorganization "has been resisted by some of the senior staff members and the departments who have been fearful that the Munitions Board would get into the operations of the departments." In any case, reorganization was bound to fail "largely because of the lack of a clear statement of Munitions Board responsibilities."[147]

Although the National Security Act identified numerous tasks to be performed by the Munitions Board, the language of the act was vague, thereby permitting different interpretations of the board's actual responsibilities. Its first responsibility, as specified in the act, illustrated the ambiguity. The board, it stated, was "to *coordinate* the *appropriate activities* within the National Military Establishment with regard to *industrial matters*, including the procurement, production, and distribution plans of the departments and agencies comprising the Establishment." The description of the duties assigned to the board that involved planning were similarly imprecise. It was to plan for the "military aspects" of industrial mobilization, for "standardization of specifications," and for the "greatest practicable allocation" of authority for one department to purchase "technical equipment and common use items" for the others. Some duties listed in the act restricted the board to making recommendations only—with respect to assigning "procurement responsibilities" among the departments; to regrouping, combining, or dissolving existing interservice agencies operating in the fields of procurement, production, and distribution; and to determining policies related to strategic and critical materials. In contrast, the board appeared to have almost unlimited and definitive authority "to determine relative priorities of the various segments of the military procurement programs." The Munitions Board was to carry out all of its duties as directed by the secretary of defense and "in support of strategic and logistical plans prepared by the Joint Chiefs of Staff."[148]

Although differing over the extent of its powers, both Secretary Forrestal and Lieutenant General Lutes envisioned a larger role for the Munitions Board than the services believed it should have. In early 1948, Forrestal did not omit much from the board's purview when he told President Truman that he intended to hold the board "responsible for effecting maximum economies and giving unified direction in all matters relating to procurement, warehousing, stockpiling, cataloging, distribution, and the military side of planning for industrial mobilization. In other words, in all industrial matters with which the Armed Services are concerned."[149] The services, however, wanted to keep the board out of their current procurement programs and operations, confining it essentially to the activities of the old Army-Navy Munitions Board, primarily mobilization planning.[150]

In June 1948, a memorandum from the Navy's general counsel to the under secretary of the Navy, commenting on a draft of the proposed governing directive for the Munitions Board, revealed just how limited some in the military departments thought its authority ought to be. The general counsel maintained that the Munitions Board could only recommend, not assign, procurement responsibilities as proposed in the directive. Furthermore, he charged, the proposed directive was "a clear usurpation of the operational functions of the individual departments" because it appeared to "empower the Munitions Board to dictate to the three Departments . . . the contract forms they should use, when they should place contracts . . . what prices they should pay . . . and how and when contracts should be terminated."[151]

Such objections notwithstanding, the directive issued by Forrestal on 9 June 1948 gave the Munitions Board broad powers and duties, including the authority to "[a]ssemble, analyze and review" the departments' "current [procurement] and mobilization programs for military requirements."[152] The service representatives on the board, however, continued to resist its intrusion into what they viewed as departmental operations.[153]

The position of the military departments apparently received some reinforcement in a revised governing directive for the board issued by Secretary Johnson on 3 November 1949. The new charter, written when the board was without a permanent chairman (1 July–24 November 1949), seemed to limit the board's sphere to current programs only as they related to mobilization requirements.[154] During this period, the board was chaired by Arthur S. Barrows, under secretary of the Air Force. On 22 September 1949, the board designated its Navy member, Assistant Secretary of the Navy John T. Koehler, to head a committee to work on a new charter. That charter was "to make it clear that the Munitions Board will not get into the internal operations of the three departments."[155]

Munitions Board officials and others in OSD disagreed that the new charter prohibited the board from reviewing the services' current procurement programs. What the restriction meant, according to M. R. McCann of the

Munitions Board's office of counsel, "is incapable [of] exact interpretation . . . ." In McCann's opinion, it was not possible to distinguish "between what the Board does in the field of mobilization planning and what it does in the field of current activities. . . ."[156] The March 1950 study of the Munitions Board prepared for OSD's Management Committee took essentially the same stance. "Congress clearly intended," stated the report, "that the Munitions Board would establish policy governing the current [procurement programs] and mobilization plans of the departments for the procurement, production and distribution of military supplies and equipment. It is obviously impossible to establish such policies without affecting the operations of the departments. . . ."[157]

Coordinated Procurement

Despite opposition from the services, many of the Munitions Board's responsibilities and the policies it established to carry them out—policies approved, after all, by the board's military department representatives—inevitably affected current procurement. This was especially true with respect to one of its principal duties—saving money by eliminating unnecessary duplication. At the Munitions Board meeting of 7 October 1948, Chairman Hargrave "informed the Board for purposes of guiding future planning that the Secretary of Defense looks to the Munitions Board as the primary agency for effecting economies and eliminating unnecessary duplication in the National Military Establishment."[158] In a continuation of efforts that preceded the National Security Act, the board intended to bring about such economies by stepping up coordinated procurement among the services.

Purchase assignment was an especially important Munitions Board method for coordinating military procurement. It took four principal forms—collaborative purchase, joint purchase, single purchase, and plant cognizance. In collaborative purchase, service procurement officials who were buying similar commodities worked out of offices located in close proximity so that they might better exchange information. The services purchased textiles and paper products by this means, an estimated 6 percent of total Defense Department procurement for FY 1949. Joint purchase accounted for a similar portion, estimated at 4.7 percent of total procurement. It involved buying for the three departments through a jointly staffed and funded organization. The Army-Navy Medical Purchasing Office (for medicines and other medical supplies) and the Armed Services Petroleum Purchasing Agency operated in this way. Together with collaborative and joint purchase, two other forms—single department purchase (projected to be just over 30 percent) and aircraft plant cognizance (almost 40 percent)—were expected to account for the more than 80 percent of about $6 billion in total procurement the military claimed would be covered through coordinated arrangements in FY 1949.[159]

Under single purchase, one service bought all of a commodity for the three departments. The National Security Act specified that this method should receive "the greatest practicable allocation of purchase authority of technical equipment and common use items," and the Munitions Board gave it high priority. In the board's view, single department procurement would save money by eliminating competition between departments that drove up prices, by reducing overhead costs of multidepartment purchasing, and by achieving lower unit costs that accompanied combined procurement.[160]

Based on previous Army-Navy Munitions Board studies and the work of its own interdepartmental "purchase assignment task committees," the Munitions Board rapidly made several single-department assignments. By January 1948, these included: watches (Army), clocks (Navy), photographic equipment (Air Force), combat ships and landing vessels (Navy), hand tools (Navy), mess and galley gear (Navy), subsistence (Army), railroad transportation equipment (Army), and locomotive cranes (Navy). Sometimes the services split purchase responsibility. The Army, for example, would acquire all amphibious vehicles, except for tracked landing vehicles, which would be purchased by the Navy.[161]

In November 1948, the Hoover Commission's Committee on the National Security Organization praised the board's work in single-department purchase.[162] Yet others had already begun to raise doubts about the program's value. In May 1948, Chairman Hargrave wrote the secretary of defense that there was not yet enough data to determine whether single-department purchase was in fact producing the anticipated savings.[163] One witness before the Committee on National Security Organization asserted that what was really going on when the services received purchase assignments was "horse trading": "Motorized cranes and shovels on rubber tires are assigned to the Army, and identical cranes and shovels mounted on caterpillar tracks are assigned to the Navy. This makes sense to no one, least of all to industry. This ridiculous assignment of construction equipment was made at the insistence of the Navy that construction equipment be split on a 40% Navy and 60% Army basis."[164] There was also evidence that the departments had not implemented some purchase assignments made in 1947.[165] Even when carried out, however, the coordination resulting from single-department purchase was limited. The services determined their requirements for a particular commodity independently. In the single-department purchase form of coordinated procurement, the purchasing service did not attempt (nor did it have the means) to evaluate another service's purchase request against total inventories or usage rates or to transfer excess stocks from one service to another.[166]

Plant cognizance, usually recognized as a fourth form of coordinated procurement, was actually a variant of single-department purchase and applied to contracts with the aircraft industry for airframes, engines, and propellers. Under plant cognizance, the Munitions Board assigned one of the services, almost always either the Air Force or Navy, to act for the others in specific manufacturing plants.

In each plant, the cognizant service would be responsible for all purchase, contract administration, inspection and transportation arrangements, and for developing recommendations for joint specifications or other forms of standardization.[167] "In other words," Lieutenant General Lutes explained to an audience at the Industrial College of the Armed Forces, "the Navy has cognizance of certain manufacturing plants with which it deals exclusively. If the Air Force wants anything manufactured in those plants, it must buy through the Navy. By the same token, the Air Force has cognizance over certain aircraft manufacturing plants, and if the Navy desires any components or any planes of that type, it must buy through the Air Force."[168] In 1949, 70 aircraft manufacturing plants were assigned either to the Air Force or to the Navy.[169]

Plant cognizance had been employed in both world wars to make the most efficient use of the aircraft industry's productive capacity. After World War II, the Aeronautical Board maintained a listing of plant cognizance assignments, but they were to apply only during wartime. In 1948, however, the Munitions Board began to apply plant cognizance during peacetime. It was both a way to use current procurement to develop mobilization capability, and one of several methods available to coordinate the substantial increases in aviation-related procurement made possible by the supplemental appropriations to the FY 1949 military budget.[170]

Coordinated Procurement and the Aviation Supplement to the FY 1949 Military Budget

In May 1948, Congress passed and President Truman signed legislation providing $3.198 billion for aviation procurement. This amount was almost three times the administration's original FY 1949 request submitted to Congress in January ($1.164 billion), and $1.25 billion more than that figure plus the $775 million supplemental appropriation the president asked for in April. The aviation appropriation, the largest single procurement item in a military budget of $13.169 billion, was handled separately from the rest of the budget. In addition, the legislation authorized immediate spending; the services did not have to await the start of the new fiscal year on 1 July 1948 to initiate contracts.[171]

Several developments during the winter of 1948 had created an environment favorable for boosting aviation spending so dramatically. The report of the President's Air Policy Commission (chaired by Philadelphia attorney Thomas K. Finletter and often referred to as the Finletter Commission) and that of the Congressional Aviation Policy Board (headed by Republican Sen. Owen D. Brewster of Maine) drew attention to the aircraft industry's depressed condition, asserted that the nation's military air power was being neglected, and called for big increases in aviation spending. Also, by early 1948, manpower shortages in the services, especially in the Army, had become acute, reflecting the overall decline in military readiness under way since the end of the war.

Finally, the Communist takeover in Czechoslovakia on 25 February 1948 and a telegram sent on 5 March by General Lucius D. Clay, the U.S. military governor in occupied Germany, warning that the Soviets might make a sudden military move in Europe, suggested that the international situation had become volatile. In this climate, the president's request for a supplement to the FY 1949 military budget not only had little trouble getting through Congress, but was augmented by an additional $800 million for aviation procurement that the president had not asked for.[172]

Worried about the impact of sharply increased defense spending on the economy—potentially causing an upsurge in inflation that might require imposition of controls—Truman had only reluctantly agreed to the supplemental appropriation. Forrestal shared these concerns.[173] Sometime early in 1948 (the President's Air Policy Commission report had been published on 12 January), Forrestal asked Lutes whether the Air Force and the Navy aircraft procurement programs should be expanded and how that would affect the aircraft industry. Lutes replied that without an approved strategic concept or thoroughly analyzed war plan, the secretary would not be on firm ground in recommending the large, five-year aircraft procurement program that the Air Force and Navy desired and that the Finletter Commission supported. On the other hand, wrote Lutes, a "moderate" increase could be justified both because of the Finletter Commission's recommendations and because the services had nearly exhausted the supply of suitable aircraft currently in storage. Furthermore, although there initially might be an electric power shortage, important especially for aluminum production, industry could undertake the expanded program.[174]

In the last week of March 1948, Truman approved a $3 billion supplemental military appropriation that included $775 million for aircraft procurement and forwarded the request to Congress on 1 April.[175] Forrestal now moved swiftly to assess further the impact of the anticipated increases on the aircraft industry and the national economy and to coordinate implementation of the services' procurement plans. He called on John A. McCone, an industrialist and former member of the Finletter Commission, and retired Maj. Gen. Oliver P. Echols, president of the Aircraft Industries Association (the industry's Washington lobbying group), to assist him. He asked McCone (a future under secretary of the Air Force and director of the CIA) to gauge the economic impact, and Echols, who had served on the Joint Aircraft Committee in World War II, to set up a similar body under the Munitions Board. Lutes provided Echols an office and supporting staff.[176] These ad hoc, informal arrangements appear unorthodox from the perspective of later decades, with their heightened sensibilities about the proper relationship between business and government.

It took only 10 days to produce the economic assessment and create the organizational structure that Forrestal desired. On 5 April, at a meeting in the Pentagon presided over by Echols, representatives from the Air Force, Navy, and Munitions Board agreed to reconstitute the existing Munitions Board Aircraft Committee and give it a new charter.[177] On 9 April, McCone attended the group's next meeting, chaired again by Echols, and described the economic assessment that he had begun:

> The problem as given to me by Secretary Forrestal is one of trying to make a determination as to whether the defense program, as now conceived, when superimposed on our present economy—which is drum-tight, as you all know with the ERP [European Recovery Program] or Marshall Plan, whichever you choose to call it, and a possible Maritime [Commission] program reported in this morning's paper—would so tax industries and sources of supply and materials as to necessitate the imposition of some type of controls; or to face the danger of an explosive inflation.

McCone then asked the assembled officers for their help in preparing the aircraft procurement portion of his overall analysis. He wanted two estimates. One should assess the impact on industry of aircraft procurement in the FY 1949 budget, including the supplement; the other should evaluate the effect on the services' long-range, five-year programs—the Air Force's plan for 70 combat groups and the Navy's for 14,500 aircraft.[178] Working together at the Air Materiel Command headquarters at Wright-Patterson Air Force Base in Dayton, Ohio, Air Force and Navy personnel completed the study in five days. They found that there would be "the usual production difficulties arising from a substantially increased program," but "no serious impact on industry."[179]

Forrestal had been wise to insist that the services coordinate aircraft procurement resulting from the supplemental appropriation. At the Aircraft Committee meeting on 9 April, Rear Adm. T. S. Combs of the Bureau of Aeronautics stated that he understood the Air Force planned to issue its FY 1949 contracts within a few days. If that were true, he said, then the Navy should do the same and "there is just no reason that I can see for this committee [to exist]." Captain Lloyd Harrison, also from the Bureau of Aeronautics, insisted the Air Force and the Bureau of Aeronautics "should release the actual contracting documents to the prime contractors on the same day . . . in order that the contract with their subcontractors will be part of a coordinated program." Brig. Gen. A. A. Kessler, Jr., from the materiel staff at Air Force headquarters, denied that the Air Force had or was about to let contracts; it had only contacted manufacturers to get some idea of their production capabilities. Rear Admiral Combs responded: "But what he [the manufacturer] believes he can do is based only on your part of it." Echols now intervened, insisting that the services would not submit their requirements independently to manufacturers but jointly through a combined delivery schedule:

> I don't know what is going on, but neither of you should sign a contract with the contractor and put in their delivery dates, except those that are on this agreed schedule. And the same thing should happen on the engines; and the same thing on the propellers, and lining gears, and anything that is at all critical. . . . It just depends on . . . when you begin to squeeze this civilian economy. You have to do

> that, or else somebody's in the soup. And that is the real purpose of the whole thing. One is to keep the thing carefully coordinated, and the second is to try and keep ahead of the game on future increases.[180]

Clearly, had Forrestal not demanded that the Air Force and Navy establish a mechanism and procedures for coordinating purchases associated with the FY 1949 supplemental appropriation, the likely result would have been a disruptive free-for-all.

Munitions Board Order No. 142 formally reconstituted the Aircraft Committee on 15 April 1948. The committee's major responsibility was to assist the board with aircraft acquisition policy and procedures, especially in coordinating "current peacetime" procurement programs for aircraft and related components. The committee's membership consisted of three flag officers from the Navy, three from the Air Force, and one from the Army. In addition, the organization would have a small permanent staff and supporting subcommittees and panels. Although a general officer from the Munitions Board staff attended the committee meetings, he was not an official member. The senior Navy and Air Force officers alternated every six months in the committee's chair.[181]

To coordinate aircraft procurement programs, the committee prepared two types of production schedules. The first, a "working" schedule, covered the services' combined requirements already under contract or those not yet under contract but for which Congress had appropriated funds. The second, a "planning" schedule, projected each service's requirements for the next five years. Schedules of both types were prepared for airframes; for major subsystems and components such as engines, propellers, radio, radar, and armament; and for guided missiles.[182] In July 1948, the Aircraft Committee completed its first schedule for Munitions Board approval—a working schedule for airframe production that listed the following information for each manufacturer and associated plant (or plants): type and model of aircraft by contracting service, airframe weight for each model and type, and number to be delivered by month during fiscal years 1949–1951.[183] Since the schedules presented an overall view of the demands to be placed on manufacturing capacity generally and in individual plants specifically, the services were able to adjust their requirements accordingly and prevent wasteful competition.

To help manufacturers obtain materials and parts to meet production schedules, the Aircraft Committee established a subordinate agency, the Aircraft Scheduling Unit. Located at Wright-Patterson Air Force Base, the Aircraft Scheduling Unit was a small organization staffed with Air Force and Navy personnel and headed by a flag officer from each service. Unlike the Aircraft Committee, a policy and planning body, the Aircraft Scheduling Unit was an operating agency. It worked directly with manufacturers and suppliers, functioning as a single point of contact for them with the services and arranging, through voluntary cooperation, for needed materials to be applied to military contracts.[184] In its first year of operation (September 1948–August 1949), the Aircraft Scheduling Unit set up "voluntary cooperative agreements" in aircraft steel warehousing, aluminum production, aircraft alloy steel fabricating mills, and in magnesium alloy sheet rolling. In the latter instance, when Consolidated Vultee, prime contractor for the B–36, reported shortages of magnesium sheet, Aircraft Scheduling Unit representatives coordinated with Dow Chemical, the producer, to determine how much additional magnesium sheet capacity would be necessary to maintain the B–36 program. The organization then assisted the Eastern Stainless Steel Company of Baltimore, Maryland, in setting up a magnesium alloy sheet rolling capability. If materials could not be located or obtained in time to meet production schedules (true for a majority of the 379 shortage requests it received from Air Force and Navy contractors during its first year), the unit arranged for rescheduling.[185]

Through Forrestal's initiative the services had achieved a degree of coordination in aircraft procurement. In early 1950, however, "Procurement of Aircraft," a study initiated by the Munitions Board and carried out by an interdepartmental survey team, showed clearly that coordinated aircraft procurement, particularly as pursued through plant cognizance, had its limits. Plant cognizance, it had been estimated, would account for about 40 percent of total military procurement in FY 1949. The reality was much different. For FY 1949, $3.198 billion had been appropriated for aviation procurement. Of that amount, the services spent about $1.9 billion for airframes, engines, and propellers, approximately two-thirds of the total appropriation. Yet, according to the Munitions Board study, only $246 million of the $1.9 billion (about 13 percent) had been purchased by one department for another under plant cognizance. The study also pointed out that although plant cognizance was commonly understood to provide for single-department responsibility in assigned plants, "the Departments can and do purchase from the same plant, administer separately their contracts, [and] maintain separate procedures and accounts of Government Furnished Property . . . ." The reason, according to the study, that a department was "reluctant" for another to purchase for it was because of unresolved differences among them about the procurement process. These included "[c]ontractual philosophy, procedures and administration . . . specification development, inspection, property accounting and spares [procurement] policy." Furthermore, resolving such differences was a "tremendously slow process" and difficult to achieve through the split jurisdiction employed in the plant cognizance form of coordinated procurement. In March 1949, recognizing this reality, the Munitions Board had authorized the services, when mutually agreeable, to deviate from the requirement for single-department purchase under plant cognizance.[186]

The Munitions Board's analysis of coordinated aircraft purchase was one of a series of studies stemming from its decision in April 1949 to survey coordinated procurement's overall effectiveness. In addition to aircraft, interdepartmental teams investigated automotive, electronics, subsistence, medical, petroleum, photographic, textiles and clothing commodities or equipment. Published in April 1950, an analysis of these studies concluded that effective procurement resulted not so much from the form employed—whether independent or coordinated purchase—but from using sound procurement practices. Coordinated procurement employing such practices was "far superior" to independent procurement, but it required a "coordinating echelon." According to the report, "[t]his coordinating activity is now discharged on a tripartite basis within the Munitions Board, which is so far removed from the operating level that it is ineffectual." Effective procurement, suggested the Munitions Board analysis, might be achieved "if all departments were deprived of the procurement function and required to participate in a self-supporting joint activity which would receive credit or blame for action."[187]

The Munitions Board after Two Years

After two years of operation under the National Security Act, the Munitions Board had not become the kind of staff agency Lieutenant General Lutes wanted, or that Forrestal told President Truman he would depend on to effect "maximum economies" and to give "unified direction" in all matters of military materiel. Certainly the board had scored successes—it was pressing ahead with the Armed Services Procurement Regulation and had brought a measure of coordination (albeit not on its own initiative) to the aircraft rearmament program of FY 1949. And there were others. But, for a number of reasons, the expectations of many, particularly in Congress, had not been fulfilled.

Like the Research and Development Board, the Munitions Board experienced instability in its leadership and its organizational structure. Both boards had had two chairmen in two years, were without a permanent chairman in the fall of 1949, and faced reorganization. Additionally, neither Forrestal nor Johnson chose to strengthen the power of either board's chairman. Resistance from the services and a cumbersome committee structure also hampered the Munitions Board, just as they did the Research and Development Board. All of these factors explain the relative weakness of both boards. Yet the Munitions Board had made less progress toward becoming an effective staff agency than its research and development counterpart. For one thing, the services exercised greater control over the Munitions Board. Its staff exercised authority over only a few of the organization's subordinate elements; in most instances, the services ran the interdepartmental committees. In contrast, theoretically neutral civilian "outsiders" played key roles on the Research and Development Board. They chaired its committees, and, when the board was without a chairman (November 1949–March 1950), its executive secretary served in that capacity. During the period the Munitions Board lacked a permanent chairman (July–November 1949), one of the military department members, the under secretary of the Air Force, chaired the board. Subject to more direct control by the services, the

Munitions Board had relatively little involvement in their procurement budgets. It made recommendations regarding only a small portion of those budgets—for example, the $100 million planned in the FY 1951 budget was intended to ensure industrial readiness in the event of war (e.g., for acquiring and maintaining manufacturing plant and equipment reserves).[188] The Research and Development Board, on the other hand, reviewed the services' full R&D programs—budgets totaling $500-$550 million annually. Lutes strongly believed the Munitions Board ought to review not only the services' procurement budgets, but together with other OSD staff elements, the entire Defense budget.[189] Finally, unlike the Research and Development Board, the Munitions Board had not developed an independent program reflecting a Defense Department as opposed to a service perspective. Through the Master Plan for Research and Development, Program Guidance, and Consolidated Technical Estimates, the Research and Development Board had begun to evolve an overarching framework, whatever its weaknesses, for military research and development. With the possible exception of the Armed Services Procurement Regulation (not actually a board initiative), the Munitions Board had nothing comparable.

* * * * *

At the end of World War II, the services controlled their own acquisition programs—from the formulation of requirements for materiel through development, production, and distribution to operating forces. In most respects, the military departments' virtual sovereignty in this regard remained intact through the end of 1949. When the services gave up some independence in acquisition policy and practice during this period, they usually did so by agreement with the other services, not as a result of direction from the secretary of defense or his staff agencies, the Research and Development Board and the Munitions Board. Thus, from one perspective, the coordinated acquisition that took place can be seen as a slow extension of the voluntary cooperation begun during World War II and continued after the war through the Army-Navy Munitions Board and Joint Research and Development Board.

From another angle, however, the National Security Act, if not producing many immediate changes, showed signs of the new defense structure's potential to alter acquisition in fundamental ways. During 1947–1949, the secretary of defense threatened service independence in acquisition most visibly and powerfully through control of the budget. The secretary, for example, established a ceiling for R&D funding and ultimately decided how much of that amount each service would receive. Most worrisome to the military departments was OSD interference in the content of acquisition programs. On 23 April 1949, Louis Johnson suddenly (after consulting only the Joint Chiefs and informing the president) cancelled construction of the Navy's supercarrier and provoked the "revolt of the admirals" (see chap. 7). Although dramatic and significant, this intrusion into a service's acquisition program was an isolated event. Moreover, both it and the determination of R&D ceilings were essentially arbitrary decisions; they were not based on any systematic relation of financial resources to military strategy. Not until the early 1960s, during Robert S. McNamara's tenure as secretary of defense and the introduction of systems analysis techniques and the Planning, Programming, and Budgeting System (PPBS), would service acquisition programs be challenged on this ground.

In addition to exercising budgetary authority, OSD influenced acquisition in other important although less visible ways. Through Research and Development Board and Munitions Board review, service acquisition policies, programs, and practices were subjected to unprecedented scrutiny. Those examinations inevitably became more searching to the extent each board developed an identity apart from the services. Lieutenant General Lutes had been frustrated by the Munitions Board's committee system, but he also saw its positive side. Implementation of jointly developed board actions, he said, "is much more apt to be wholehearted, rapid, and effective." Additionally, "[p]lacing working-level people in day-to-day jobs that require them to learn about and consider the operations and problems of all three Services has generated invaluable interests in unification."[190] Somewhat similar results very likely occurred with civilian professionals from science and industry who participated in Research and Development Board and Munitions Board activities. They became used to examining military matters from the broader Defense Department perspective as opposed to the narrower individual service viewpoint. Of most significance, many of these civilians continued ties with the military that had been established during World War II. Early in 1949, Julius Stratton, former chairman of the Research and Development Board's Committee on Electronics, wrote Compton: "Inevitably this association is going to grow. Warfare is increasingly technical and enormously complex. The inherent nature of military life is not conducive to the development of outstanding technical minds in adequate numbers, so that the Armed Services are compelled to turn to industry and to the universities for help. Civilians have settled on to the Military like the chestnut blight, and doubtless are there to stay."[191]

Endnotes

1. Rear Adm. Morton L. Ring, "Coordination of Procurement Under the National Security Act and Procurement by the Department of the Navy," address to the Industrial College of the Armed Forces (ICAF), Fort Lesley J. McNair, Washington, D.C., 16 November 1948, 1-2. A transcript of this and hundreds of the guest lectures given at ICAF from 1946 through 1965, including the question and answer periods, are available at the National Defense University Library located at Ft. McNair or through the Library section (Digital Collections) of its internet site: http://www.ndu.edu [hereafter NDU Library].
2. An August 1949 amendment to the National Security Act redesignated the National Military Establishment as the Department of Defense.
3. For a concise summary of the origins and content of the National Security Act of 1947

(Public Law 253, 80th Cong., lst sess., 26 July 1947), see Steven L. Rearden, *The Formative Years, 1947–1950*, 16-27. For the text of the act, see "The National Security Act of 1947—26 July 1947," in *The Department of Defense: Documents on Establishment and Organization, 1944–1978*, ed. Alice C. Cole, Alfred Goldberg, Samuel A. Tucker, and Rudolph Winnacker, 35-50. For an example of the expectation that military unification would save money, see Harry S. Truman, "Special Message to Congress Recommending the Establishment of a Department of National Defense," 19 December 1945, *Public Papers of the Presidents of the United States: Harry S. Truman, 1945*, 552-53. According to Rearden, many congressmen supported the act for this reason (p. 50).

4. Michael S. Sherry, *Preparing for the Next War: American Plans for Postwar Defense, 1941–1945*, 120-58; Nathan Reingold, "Vannevar Bush's New Deal for Research: Or the Triumph of the Old Order," *Historical Studies in the Physical and Biological Sciences* 17, no. 2 (1987): 338-39; G. Pascal Zachary, *Endless Frontier: Vannevar Bush, Engineer of the American Century*, 218-60, 312-45; and Daniel J. Kevles, *The Physicists: The History of a Scientific Community in Modern America*, 308-23, 340-41, 349-66.

5. Daniel J. Kevles, "Scientists, the Military, and the Control of Postwar Defense Research: The Case of the Research Board for National Security," *Technology and Culture* 16, no. 1 (January 1975): 20-47; and Sherry, *Preparing for the Next War*, 141-58.

6. Allan A. Needell, *Science, Cold War and the American State: Lloyd V. Berkner and the Balance of Professional Ideals*, 97-126.

7. After a year of operation, the Joint Research and Development Board had nearly 200 full-time employees (about 75 were professional staff, including military officers; the rest were support staff), and approximately 350 part-time employees (of these, only about 20 percent received compensation). See L. V. Berkner, *Annual Report of the Executive Secretary*, Joint Research and Development Board, 30 June 1947, 31-32, folder 7, box 25, entry 341, RG 330.

8. Ibid., 14 [italics added].

9. Ibid., 13; and Executive Office of the President, Office of Management and Budget, *Historical Tables, Budget of the United States Government, Fiscal Year 2002*, Table 3.1 (Outlays by Superfunction and Function: 1940–2006), 44.

10. Berkner, *Annual Report*, 30 June 1947, 13-14, 16-17; ltr, V. Bush to Secretary of War Robert P. Patterson [identical ltr to Secretary of the Navy James V. Forrestal], 18 July 1947, folder 11, box 25, entry 341, RG 330; and Needell, *Science*, 114-17.

11. Quoted in Berkner, *Annual Report*, 30 June 1947, 11.

12. Ltr, Bush to Patterson [identical ltr to Forrestal], 21 May 1946, folder 4, box 18, entry 341, RG 330; and ltr, Bush to Senator B. B. Hickenlooper, Chairman, Joint Committee on Atomic Energy, 14 May 1947, folder 5, box 25, entry 341, RG 330.

13. Vannevar Bush, "Organization of Research and Development," 7.

14. Berkner, *Annual Report*, 30 June 1947, 193.

15. Ltr, Bush to Patterson, 18 July 1947.

16. Ibid.; Berkner, *Annual Report,* 30 June 1947, vii, 111-223, esp. 117, 214-15; and "The Joint Research and Development Board," n.d., 26-27, folder RDB History, box 829 (Research and Development Board, 1947– 1952), Subject Files, Historical Office, Office of the Secretary of Defense. [hereafter OSD/HO].

17. Berkner, *Annual Report,* 30 June 1947, 58-60, 100-01; and ltr, Bush to Hickenlooper, 14 May 1947.

18. Needell, *Science*, 113.

19. Rearden, *Formative Years,* 96-103; and "The National Security Act of 1947," *Department of Defense: Documents on Establishment and Organization*, 47.

20. By the time he left office in 1949, Forrestal had concluded that the powers of the secretary of defense should be increased. For Forrestal's view of unification and his role in it as the first secretary of defense, see Rearden, *Formative Years,* 32-40.

21. "Directive, Research and Development Board," 18 December 1947, folder Research

and Development Board, 1947–1952, box 829 (Research and Development Board, 1947–1952), Subject Files, OSD/HO; and Lawrence R. Hafstad, "Coordination of Research and Development," address to Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 22 September 1948, 8, NDU Library.

22. Lawrence R. Hafstad, *Annual Report of the Executive Secretary*, Research and Development Board, 17 September 1948, folder 25, box 341, entry 341, RG 330.

23. Table (Civilian Employment and Assigned Military Personnel—Office of the Secretary of Defense), Progress Reports and Statistics, Office of the Secretary of Defense, 3 March 1953, folder Miscellaneous, box 521 (Rockefeller Committee Files, 1948–1953), Subject Files, OSD/HO; "Organizing RDB," 28, folder RDB History, box 829 (Research and Development Board, 1947–1952), Subject Files, OSD/HO; memo, Gen. Joseph T. McNarney [Air Force member, Research and Development Board] for Chairman, Research and Development Board, 19 March 1949, sub: Structure of the RDB Below the Committee Level; and memo, Special Group Appointed to Study Committee Structure, 23 March 1949, sub: Review of Research and Development Board Committee Structure: both in folder 1, box 585, entry 341, RG 330; ltr, Karl T. Compton to the President, 2 November 1949, folder 14, box 40, entry 341, RG 330; and Rearden, *Formative Years*, 99.

24. Memo, McNarney for Chairman, Research and Development Board, 19 March 1949; and Hafstad, *Annual Report*, 17 September 1948, 1, 30-31.

25. Memo, K. T. C. [Karl T. Compton] for Mr. Richardson [F. H. Richardson, deputy executive secretary, Research and Development Board], 24 February 1949, folder 1, box 585, entry 341, RG 330.

26. Initially, the Research and Development Board forwarded individual committee reports as program guidance to the departments. In March 1950, these reports were consolidated in one document. See Hafstad, *Annual Report*, 17 September 1948, 15; Robert F. Rinehart, *Annual Report of the Executive Secretary*, Research and Development Board, 31 December 1949, 4, folder 7, box 25, entry 341, RG 330; and RDB 200/20, Program Guidance, 1 March 1950, folder 22, box 36, entry 341, RG 330.

27. The board rapidly prepared an interim plan and issued it to the departments in April 1948. See Hafstad, *Annual Report*, 17 September 1948, 15. Examples are from RDB 169/3, Master Plan for Research and Development, 24 February 1949, folder 1, box 473, entry 341, RG 330. The last Master Plan prepared by the board prior to the Korean War was RDB 169/33, Master Plan for Research and Development, 18 January 1950, folder 1, box 34, entry 341, RG 330.

28. RDB 162/1, Consolidated Technical Estimates, 1948, 1 September 1948; and RDB 162/14, Consolidated Technical Estimates, 1949, 29 September 1949: both in bulky package, pt. 1, box 127, file CCS 334, Res. & Dev. Bd. (2-28-46), entry 5 (Central Decimal File, 1948–1950), RG 218 (Records of the U.S. Joint Chiefs of Staff), Archives II.

29. Operations research (sometimes "operational research," or "operations analysis") is the application of scientific analysis, particularly mathematical methods, to the solution of problems involving complex systems. It first emerged during World War I, but was used extensively just prior to and during World War II, initially by the British with respect to radar's interaction with other elements of their air defense system. [Definition is from Stephen B. Johnson, *The United States Air Force and the Culture of Innovation, 1945–1965*, 14.] For the British experience in World War II, see Joseph F. McCloskey, "The Beginnings of Operations Research: 1934–1941," *Operations Research* 35, no. 1 (1987): 143-52; and United Kingdom Air Ministry, *Origins and Development of Operational Research in the Royal Air Force*, Air Publication 3368. For U.S. operations research, see McCloskey, "U.S. Operations Research in World War II," *Operations Research* 35, no. 6 (1987): 910-25; M. Fortun and S. S. Schweber, "Scientists and the Legacy of World War II: The Case of Operations Research," *Social Studies of Science* 23 (1993): 595-642; and Erik P. Rau, "The Adoption of Operations Research in the United States during World War II," in *Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After*, ed. Agatha C. Hughes and Thomas P. Hughes, 57-92. The operations

research activities conducted by the services during the war became permanent parts of their postwar organizations. For a detailed history of operations research in the Navy, see Keith R. Tidman, *The Operations Evaluation Group: A History of Naval Operations Analysis*; and for the Army, see Charles R. Shrader, *History of Operations Research in the United States Army*, Vol. I, *1942–1962*. For a short overview of the history of operations research in the Air Force, see I. B. Holley, jr., "The Evolution of Operations Research and Its Impact on the Military Establishment: The Air Force Experience," in *Science, Technology, and Warfare: The Proceedings of the Third Military History Symposium, United States Air Force Academy, 8–9 May 1969*, ed. Monte D. Wright and Lawrence J. Paszek, 89-109.

30. For the origins and evolution of the Weapons Systems Evaluation Group through early 1950, see John Ponturo, *Analytical Support for the Joint Chiefs of Staff: The WSEG Experience, 1948–1976*, xii-xiii, 5-128; and Rearden, *Formative Years,* 99, 401-02, 405, 409-10. Quotation is from Directive, Weapons Systems Evaluation Group, 11 December 1948, encl. to memo, James Forrestal for the Joint Chiefs of Staff and Chairman, Research and Development Board, 11 December 1948, sub: Establishment of Weapons System Evaluation Group, box 829 (Research and Development Board, 1947–1952), Subject Files, OSD/HO.

31. Memo, Gen. Joseph T. McNarney for the Secretary of Defense, 29 October 1948, sub: Research and Development Board, folder Research and Development Board, Organization and Functions, box 829 (Research and Development Board, 1947–1952), Subject Files, OSD/HO.

32. Rearden, *Formative Years*, esp. 393-402.

33. Memo, R. F. Rinehart for Dr. Compton, 22 March 1949, sub: Further Comments by Executive Directors on Limitations of Committee Actions, folder 1, box 585, entry 341, RG 330.

34. Lt. Gen. H. S. Aurand to Distribution List, 21 June 1948, sub: Minutes of the Conference of Army Representatives to the RDB, sec. 3, box 126, file CCS 334 Res. & Dev. Board (2-28-46), entry 5, RG 218.

35. Memo, Ralph L. Clark [former director, Programs Division, JRDB and RDB, 1947–1949] for Dr. K. T. Compton, ca. June 1949, sub: Research and Development Board, 14, folder 5, box 583, entry 341, RG 330.

36. Aurand to Distribution List, 21 June 1948.

37. Rinehart, *Annual Report*, 31 December 1949, 19.

38. Memo, Gen. Jacob L. Devers and Maj. Gen. C. G. Helmick [Army members, RDB] for Chairman, Research and Development Board, 25 August 1949, sub: Reduction of Expenditures Within the Department of Defense, folder 1, box 591, entry 341, RG 330.

39. Memo, James Forrestal for the Joint Chiefs of Staff, 17 October 1947, sub: Relations of Joint Chiefs of Staff with the Research and Development Board, folder 5, box 584, entry 341, RG 330.

40. James Forrestal, Report to the President from the Secretary of Defense, 29 February 1948, 28, folder CD 25-1-11, box 110, entry 199 (Office, Administrative Secretary, Correspondence Control Section, Numerical File, Sept. 1947–June 1950), RG 330. In 1948, only the Air Force had aircraft (B–29, B–50, B–36) that could deliver atomic bombs on targets in the Soviet Union from long range. The Navy, however, was developing aircraft (AJ–1 Savage and P2V–3C Neptune) that would be able to carry the large and heavy atomic bombs of the day. It was also modifying some of its carriers to handle these aircraft, and had begun work on a "flush-deck" carrier (no fixed superstructure) that would enable aircraft with substantially longer wingspans than those in the existing inventory to operate from its flight deck. See chap. 7 in this volume.

41. Kenneth W. Condit, *The Joint Chiefs of Staff and National Policy*, *1947–1949*, 156-58. One historian who has written an in-depth study of JCS war plans during these years defines a "strategic concept" in that context as "establishing a foundation for detailed war planning by describing in broad outline how and where a war would begin, the course of the initial operations, and a strategic approach that would enable the United States and its allies to impose acceptable surrender terms upon the aggressor." See Steven T. Ross, *American War Plans, 1945–*

1950, 25.
42. JCS 1630/10, General Guidance on Strategic Concepts, 5 May 1948, sec. 1, box 183, file CCS 381 (2-18-46), entry 5, RG 218.
43. Memo, L. R. Hafstad for the Secretary, Joint Chiefs of Staff, 9 September 1948, sub: Guidance for RDB Master Plan, file CCS 000.96 (4-1-48), box 3, entry 5, RG 218.
44. Quoted in "Estimates of RDB under Dr. Bush's Chairmanship," 3, folder RDB History, box 829 (Research and Development Board, 1947–1952), Subject Files, OSD/HO.
45. Hafstad, *Annual Report*, 17 September 1948, 27. At the Industrial College of the Armed Forces on 22 September, Hafstad, in response to a question about avoiding duplication in service missile projects, said: "It is one of our major headaches. . . . The missing information is what we call the military worth of the different guided missiles. . . . We need help from the Joint Chiefs of Staff. They must tell us, from the military point of view, whether it is more important to have a 500-mile guided missile with such and such accuracy to bombard a town than it is to have an airplane and whether it is cheaper to do it by guided missiles than it is by airplane." See Hafstad, "Coordination of Research and Development," 22 September 1948, 24.
46. Memo, Hafstad for Secretary, Joint Chiefs of Staff, 9 September 1948. folder CCS 000.96 (4-1-48), box 3, entry 5, RG 218.
47. JCS 1862/1, Interim Plan for Research and Development in the National Military Establishment, 15 September 1948, folder CCS 000.96 (4-1-48), box 3, entry 5, RG 218.
48. See *Report to the Commission on Organization of the Executive Branch of the Government by the Committee on the National Security Organization*, 15 November 1948, Vol. III, 16, 21-23 (copy in OSD/HO). [hereafter Hoover Commission Committee on National Security Organization report].
49. Ltr, J. A. Stratton to Dr. Karl T. Compton, 14 February 1949, 12, folder 4, box 592, entry 341, RG 330.
50. In 1953, during a session of the Committee on Department of Defense Organization (the Rockefeller Committee), Bush stated flatly: "I never sat with the American Joint Chiefs of Staff." See Gen. J. Lawton Collins, "Statement for Committee on Department of Defense Organization," 42, 22 March 1953, folder Collins, box 519 (Rockefeller Committee—Testimony of Witnesses, 1953), Subject Files, OSD/HO; Rearden, *Formative Years*, 98; and Zachary, *Endless Frontier*, 337.
51. Hafstad, *Annual Report*, 17 September 1948, 10-11.
52. J. C. Mouzon and R. J. White, "Compilation of Comments on RDB Secretariat and Committees," 26 May 1949, folder 1, box 585, Entry 341, RG 330.
53. Memo, C. S. Piggot, Executive Director, Committee on Geophysical Sciences, for Executive Secretary, 12 May 1948, sub: Research and Development Board Discharge of its Basic Responsibilities—Comments Thereon, folder 2, box 585, entry 341, RG 330; and memo, Rinehart for Compton, 22 March 1949.
54. Memo, RME [Richard M. Emberson, assistant executive secretary, RDB] for Dr. R. F. Rinehart, 21 March 1949, sub: Executive Directors' Comments on Limitations of Committee Actions, as Developed during Recent Discussions Concerning Proposed Regulations for the Control of R&D Obligations, folder 1, box 585, entry 341, RG 330.
55. Ibid.
56. Memo, Rinehart for Compton, 22 March 1949; ltr, Frederick L. Hovde, President Purdue University [former chairman, Guided Missiles Committee] to Dr. Robert E. Wilson, Chairman of the Board, Standard Oil Company (Indiana) [chairman, RDB Special Advisory Group], 28 December 1949, folder 3, box 592, entry 341, RG 330.
57. Memo, McNarney for Secretary of Defense, 29 October 1948.
58. Tentative Report of Special Advisory Group to the Chairman, Research and Development Board, 27 February 1950, 4, folder 4, box 592, entry 341, RG 330.
59. Memo, R. F. Rinehart for Dr. Compton, 19 September 1949, sub: Notes on the Meeting with the Committee Chairmen, folder 3, box 585, entry 341, RG 330.

60. The Tasks of the RDB [paper prepared by RDB staff for first meeting of Special Advisory Group, 6 December 1949], folder 3, box 592, entry 341, RG 330.
61. See, for example, the sharp exchange between Clark B. Millikan, chairman of the Committee on Guided Missiles, and Rinehart, executive secretary and acting chairman, Research and Development Board, in memo, Clark B. Millikan for Acting Chairman, Research and Development Board, 1 December 1949, and ltr, R. F. Rinehart to Dr. Millikan, 16 December 1949: both in folder 1, box 585, entry 341, RG 330; and Tentative Report of the Special Advisory Group, 27 February 1950, 4.
62. Memo, Karl F. Kellerman for Executive Secretary, RDB, 13 May 1948, sub: Discharge of Basic Responsibilities by RDB, folder 2, box 585, entry 341, RG 330.
63. Agenda, Meeting of the Executive Secretary with Executive Directors, 28 May 1948, item 2 (Conflicts in Committee and Panel Directives) with atch (Areas of Overlap Among Committee Fields of Interest), folder 4, box 341, entry 341, RG 330.
64. Ltr, Donald A. Quarles to Dr. Karl T. Compton, 30 March 1949, folder 1, box 585, entry 341, RG 330. According to one report, "Basic Physical Science is so involved with overlaps that this Committee and its panels seem thoroughly confused." See Mouzon and White, "Compilation of Comments," 26 May 1949.
65. Memo, McNarney for Chairman, Research and Development Board, 19 March 1949.
66. Ltr, K. T. Compton to Gen. Joseph T. McNarney, 28 March 1949, folder 1, box 585, entry 341, RG 330.
67. Rinehart, *Annual Report*, 31 December 1949, 36-37.
68. Hafstad, *Annual Report*, 17 September 1948, 10-11.
69. Memo, Norman L. Winter, Executive Director, Committee on Electronics, for Executive Secretary, RDB, 13 May 1948, sub: Research and Development Board Discharge of its Basic Responsibilities, folder 2, box 585; ltr, I. A. Getting [member, Committee on Electronics] to Dr. K. T. Compton, 22 October 1948, folder 2, box 585; memo, R. M. Emberson for Dr. Rinehart, 13 May 1949, folder 1, box 585; memo, Karl T. Compton for Dr. Rinehart, Mr. Richardson, 16 June 1949, sub: Discussion with Dr. M. J. Kelly [chairman, Navigation Committee] and Committee on Navigation, "RDB Committee Operations," 15 March 1949: both in folder 1, box 585; app. IV (Review of Budget, Fiscal and Information Operations of RDB) to memo, Clark for Compton, ca. June 1949; and RDB 67/2, Staff Study on the Information and Report Requirements of RDB, 13 October 1949, 5-6, folder 1, box 24: all in entry 341, RG 330.
70. C. S. Piggot, Report, Survey of Research and Development Effort of National Military Establishment, 27 May 1949, 1-2, folder 44, box 341, entry 341, RG 330.
71. Memo, V. Bush for Secretary of Defense, 20 August 1948, sub: Research and Development Requirements for F. Y. 1950, folder 2, box 490, entry 341, RG 330; memo, McNarney for Secretary of Defense, 29 October 1948; and RDB 54/13, Staff Study on Principles of Accounting for Research and Development, 7 October 1949, folder 4, box 22, entry 341, RG 330.
72. Memo, Brig. Gen. D. L. Putt, Air Force Member, Research and Development Board, for Chairman, Research and Development Board, 8 September 1949, sub: Reduction of Expenditures within the Department of Defense, folder 12, box 37, entry 341, RG 330; and Hafstad, "Coordination of Research and Development," 22 September 1948, 19-20.
73. FY 1951 RDB Budget Presentation before JCS Budget Advisory Committee, 15 July 1949, 11, folder 4, box 38, entry 341, RG 330.
74. Ltr, Compton to the President, 2 November 1949.
75. In FY 1949, the total budget was $13.169 billion with $629 million appropriated for R&D; in FY 1950, $14.346 billion with $612 million for R&D. Figures for the total budgets are from Rearden, *Formative Years*, 333, 360; the R&D figures are from table (Research and Development Amounts Requested of Congress and Amounts Appropriated), 9 June 1953, atch to memo, W. H. Mautz, Director, Economic and Security Estimates Division, OSD, for Gordon Nease, Senate Appropriations Committee, 11 June 1953, sub: Budget Requests and

Appropriations for Research and Development, folder Revised FY 1954 Budget, box 7, Budget Files, FY 1954, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO.
76. Roger R. Trask and Alfred Goldberg, *The Department of Defense, 1947–1997: Organization and Leaders*, 59.
77. The Army went along with Bush in recommending $550 million; the Navy and Air Force members of the board, however, thought that at least $800 million would be necessary. Bush attached their dissent to the memorandum he sent to Forrestal. See memo, V. Bush for Secretary of Defense, 20 August 1948; and memo, Lt. Gen. B. W. Chidlaw, Maj. Gen. L. C. Craigie, Vice Adm. E. W. Mills, and Vice Adm. J. D. Price for Secretary of Defense, 20 August 1948, sub: Research and Development Requirements for Fiscal Year 1950, folder 6, box 30: both in entry 341, RG 330.
78. Memo, Louis Johnson for Secretaries of the Army, Navy and Air Force, 16 July 1949, sub: Research and Development Portions of Department Budget Estimates, folder 4, box 38; and memo, Louis Johnson for Chairman, Research and Development Board, 16 February 1950, sub: Budget Planning Figures for Research and Development Fiscal Year 1952, folder 10, box 40: both in entry 341, RG 330. For Johnson's budget-cutting attitude, see Rearden, *Formative Years*, 48, 68-69, 138-39, 354-55, 367, 405, 522, 539, 541.
79. Memo, Johnson for Secretaries of the Army, Navy and Air Force, 16 July 1949; and memo, Johnson for Chairman, Research and Development Board, 16 February 1950.
80. Memo, V. Bush for Secretary of Defense, 20 August 1948.
81. Memo, James Forrestal for Chairman, Research and Development Board, 3 March 1949, folder 3, box 37, entry 341, RG 330.
82. Memo, Archibald S. Alexander, Assistant Secretary of the Army, for Acting Chairman, Research and Development Board, 30 December 1949, folder 9, box 40, entry 341, RG 330.
83. Memo, Ralph L. Clark for Dr. K. T. Compton, ca. June 1949, sub: Research and Development Board, folder 5, box 583, entry 341, RG 330.
84. Memo, R. M. Emberson for Dr. Rinehart, 13 May 1949.
85. Memo, Donald G. Marquis for Chairman, Research and Development Board, 28 June 1949, sub: Comments on Navy Dissent from Committee on Human Resources Budget Recommendations, folder 1, box 59, entry 341, RG 330.
86. Memo, V. Bush for Secretary of Defense, 20 August 1948. See also memo, V. Bush for Mr. W. J. McNeil, Special Assistant to Secretary of Defense, 6 April 1948, sub: Increase in Funds for Research and Development, folder 2, box 585; and Hafstad, *Annual Report*, 17 September 1948, 2: both in entry 341, RG 330.
87. Memo, Louis Johnson for Acting Chairman, Research and Development Board, 26 January 1950, sub: Research and Development Planning Figures for F.Y. 1952, folder 10, box 40, entry 341, RG 330. Johnson was very likely influenced by the recommendations contained in the report of the Special Advisory Group chaired by Robert Wilson. Although the report was not officially published until 27 February 1950, a draft was circulating as early as 19 January. See Tentative Report of Special Advisory Group, 27 February 1950, 1, 14-15; ltr, DuBridge to Wilson, 24 February 1950; and ltr, William Webster, Chairman, Research and Development Board, to Robert E. Wilson, 6 July 1950: all in folder 4, box 592, entry 341, RG 330.
88. Memo, Johnson for Chairman, Research and Development Board, 16 February 1950.
89. Rinehart, *Annual Report*, 31 December 1949, 23-24.
90. Ltr, L. A. DuBridge, President, California Institute of Technology, to Robert E. Wilson, 24 February 1950, folder 4, box 592, entry 341, RG 330.
91. Hoover Commission Committee on National Security Organization report, Vol. III, 19.
92. Robert J. Watson, *Into the Missile Age, 1956–1960*, 186-91.
93. Hanson W. Baldwin, "Defense 'Front' Develops," *New York Times,* 23 January 1950, 12.
94. Memo, Marquis for Chairman, Research and Development Board, 28 June 1949; memo, Rinehart for Compton, 19 September 1949; and memo, H. E. Landsberg, Secretary, Special Advisory Group, for Members Special Advisory Group, 27 January 1950, sub: Dr. George P.

Baker's [member of Special Advisory Group] Comments on Draft Report, folder 4, box 592, entry 341, RG 330.

95. Ltr, Stratton to Compton, 14 February 1949. See also ltr, J. A. Stratton to Dr. Karl T. Compton, 24 March 1949, folder 1, box 585, entry 341, RG 330. For other expressions of these concerns, see memo, Clark for Compton, ca. June 1949; ltr, DuBridge to Robert E. Wilson, 24 February 1950; and ltr, I. L. Baldwin, Chairman, Committee on Biological Warfare to Dr. Karl T. Compton, 28 September 1949, sub: Proposed Reorganization of the Structure of the Board and Suggestions Regarding Personnel for a Study Committee, folder 3, box 585, entry 341, RG 330.

96. Ltr, Compton to the President, 2 November 1949.

97. Rinehart, *Annual Report*, 31 December 1949, 8.

98. Tentative Report of Special Advisory Group, 27 February 1950, 6.

99. Memo, Townsend Hoopes [secretary of the Armed Forces Policy Council] for Members of the Armed Forces Policy Council, 17 January 1950, sub: Significant Actions of the Armed Forces Policy Council at its Meeting of 17 January, sec. 5, box 103, file CCS 334 Armed Forces Policy Council (12-2-47), entry 5, RG 218.

100. Rearden, *Formative Years*, 54, 101. The 1949 legislation actually permitted the secretary of defense to give the Research and Development Board chairman decision power on all matters within the board's jurisdiction. Significantly, Johnson chose a more restricted interpretation.

101. Maj. Gen. Orval R. Cook, Deputy Director of Service, Supply, and Procurement, Army Staff, address to the Armed Forces Staff College, Norfolk, Va., 26 February 1948, 1-2, folder Reading File, 1948, Dr. Cassidy, Logistics, box 93, entry 221 (Records of Dr. Elliott Cassidy Accumulated While Serving as Historian and Special Assistant to the Chairman of the Munitions Board, 1948–1953), RG 330. Although an Air Force officer, Cook had not yet left his assignment on the Army staff (formerly the War Department General Staff) as the transition to an independent Air Force took place.

102. Harry S. Truman, "Our Armed Forces Must Be Unified," *Collier's* 114, no. 9 (26 August 1944): 16, 63-64.

103. William H. Draper, Jr., and Lewis L. Strauss, *Coordination of Procurement between the War and Navy Departments*, Vol. I, *Final and Interim Reports*, February 1945, passim, in Senate Committee on Military Affairs, *Department of Armed Forces, Department of Military Security: Hearings before the Committee on Military Affairs on S. 84 and S. 1482*, 79th Cong., 1st sess., 1945, 657-701[copies of Vol. 1, Vol. 2 (*Functional Studies*), and Vol. 3 (*Materiel Studies*) are in the NDU Library]; memo, Brig. Gen. Wayne Allen for Honorable Edwin W. Pauley, Special Assistant to the Secretary of the Army, sub: Centralized Control of Purchasing in the Armed Forces, 7 January 1948, 6-7, folder Reading File 1948, Dr. Cassidy, Logistics, box 93, entry 221, RG 330; Cook, address to the Armed Forces Staff College, 26 February 1948, 9-13; and History of Procurement Assignment, 17 January 1957, 1-3, sec. Procurement Assignments, black binder (Supply and Logistics, 1949–1959), box 954 (Assistant Secretary of Defense, Supply & Logistics, Monthly Reports & Other Documents, 1953 –1958), Subject Files, OSD/HO. [hereafter History of Procurement Assignment, 17 January 1957]. For coordinated aircraft procurement during World War II, see Irving Brinton Holley, jr., *Buying Aircraft: Matériel Procurement for the Army Air Forces*, 263-73. In addition to subsistence, the other cases of single service procurement were crawler tractors (Army), chemical warfare equipment (Army), small arms and small arms ammunition (Army), and 12-inch or larger ammunition (Navy).

104. Draper and Strauss, *Final and Interim Reports*, in *Hearings on S. 84 and S. 1482*, 661-62.

105. Ibid., 663-64.

106. Memo, Allen for Pauley, 7 January 1948, 5; and Cook, address to the Armed Forces Staff College, 26 February 1948, 15: both in folder Reading File 1948, Dr. Cassidy, Logistics, box 93, entry 221, RG 330.

107. Organizational History of the Munitions Board, 24 August 1948, 1-3, folder Organization and Functions, 1942–1948, Vol. 1, box 88, entry 221, RG 330. Richard R. Deupree became

the first executive chairman of the Army-Navy Munitions Board on 8 February 1946; he was succeeded by Thomas J. Hargrave on 1 July 1947.

108. Ibid.

109. Memo, Maj. Gen. E. M. Powers, Chairman, Munitions Board Procurement Policy Council, for Chairman, Munitions Board, 12 January 1948, sub: Report of the Munitions Board Procurement Policy Council from 31 October 1946 to 24 September 1947, folder Material Submitted to Look Magazine, box 100, entry 221, RG 330.

110. Ibid; and memo [Lt. Gen. LeRoy Lutes, director, Service, Supply, and Procurement Division, Army Staff] for the Chief of Staff, United States Army, n.d., sub: Accomplishments of the Service, Supply, and Procurement Division, 11 June 1946 to 31 December 1947, attaching Report of Accomplishments, 15 January 1948, folder Reading File 1948, Dr. Cassidy, Logistics, box 93, entry 221, RG 330.

111. Statement of W. John Kenney, 4 February 1947, House Committee on Armed Services, Subcommittee No. 6, *To Facilitate Procurement of Supplies and Services by the War and Navy Departments, and for other Purposes*: *Hearings on H.R. 1366*, 80th Cong., 1st sess., 469.

112. Ibid., 470; and Carl Schreiber, "The Armed Services Procurement Act of 1947: An Administrative Study" (Ph.D. diss., American University, 1964), 24-28. The Procurement Policy Board's report is included as exhibit A to Kenney's statement, 485-87. For the origins of the act from the perspective of a major participant in its drafting, see Capt. Mark E. Andrews, acting chief, Procurement Branch, Office of the Assistant Secretary of the Navy, "Navy Department Organization for Procurement," address to the Army Industrial College," Fort Lesley J. McNair, Washington, D.C., 1 February 1946, 1-5, NDU Library.

113. James F. Nagle, *A History of Government Contracting*, 2d ed., 391-93, 399-406, 415-26; Robert Higgs, "Private Profit, Public Risk: Institutional Antecedents of the Modern Military Procurement System in the Rearmament Program of 1940–1941," in *The Sinews of War: Essays on the Economic History of World War II*, ed. Geoffrey T. Mills and Hugh Rockoff, 174-77; Commission on Government Procurement, app. G, (Historical Development of the Procurement Process), *Report,* 170-71; and John Perry Miller, "Military Procurement Policies: World War II and Today," *The American Economic Review* 42, no. 2 (May 1952): 458-59.

114. Statement of W. John Kenney, 4 February 1947, 470.

115. In FY 1949, 70.2 percent of contracts awarded by the Department of Defense were negotiated; in FY 1950, 72.7 percent. From FY 1951 through FY 1963, over 80 percent (usually over 85 percent) were negotiated. See Schreiber, "Armed Services Procurement Act," 47-50, for the seventeen exceptions, and table 1, 386, for the contract figures.

116. (62 stat. 21) *Armed Services Procurement Act of 1947*, Public Law 413, 80th Cong., 2d sess. 19 February 1948, 1-2.

117. Mark E. Andrews, "Armed Services Procurement Act," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 26 October 1948, 5, NDU Library. During his introduction of the guest speaker, the commandant of the college pointed out that Andrews was often referred to as the "father" of the act.

118. Harold J. Margulis and Harry B. Yoshpe, *National Security Management: Procurement*, 56.

119. Statement of W. John Kenney, 4 February 1947, 475; and Margulis and Yoshpe, *Procurement*, 57.

120. (62 stat. 21) *Armed Services Procurement Act of 1947*, 19 February 1948, 2.

121. Statement of W. John Kenney, 4 February 1947, 477.

122. Margulis and Yoshpe, *Procurement*, 58.

123. Extract of ltr, President Harry S. Truman to Secretary of Defense, 19 February 1948, in Foreword to *Armed Services Procurement Regulation*, 19 May 1948, copy in folder Aircraft Appropriations and Procurement, box 1, entry 210 (Records of Col. Lawrence B. Ocamb Accumulated During His Assignment to Coordinate and Analyze Surveys Dealing With Aircraft Procurement and Appropriations for the Armed Forces, Jan.–June 1948), RG 330; and Nagle, *History of Government Contracting*, 485.

124. Hargrave had to be prodded to come back to town for the Munitions Board's presentation before the Hoover Commission's Committee on National Security Organization scheduled for 24 August 1948. See ltr, S. W. Cramer, Jr. [deputy chairman of the Munitions Board and a civilian], to Jean [Thomas J. Hargrave], 5 August 1948 ("Of course everybody wants you here, but I gather you can't make it."); ltr, S. W. Cramer, Jr., to Jean, 12 August 1948 ("I know how you feel about coming down but wanted to advise you of this situation, as, of course, the whole record of your administration as Chairman of the Board is involved. If you can't come, you may be sure that we will do the very best possible job to defend the Board, its performance, and your policies."); and finally (after an apparently sudden reversal of plans), ltr, S. W. Cramer, Jr., to Jean, 20 August 1948 ("I am enclosing the latest schedule received from the Eberstadt Committee on its Munitions Board presentation on Tuesday . . . We are arranging for a repetition of the dry-run we had this morning to be given [to] you Monday afternoon, if you want it."): all in folder White File, S. W. Cramer, Jr., box 122, entry 231 (Records Maintained by the Munitions Board Chairmen, July 1947–Sept. 1950), RG 330.
125. Rearden, *Formative Years*, 91, 95.
126. Forrestal, Report to the President, 29 February 1948, 9; LeRoy Lutes biographical file, U.S. Army Center of Military History library and archives, Fort Lesley J. McNair, D.C.; and Rearden, *Formative Years*, 92-94.
127. Organizational Planning Division, Office of the Secretary of Defense, "Functions and Organization of the Munitions Board," 17 March 1948, 2, folder Organization and Functions, 1942–1948, Vol. 1, box 88, entry 221, RG 330.
128. Hoover Commission Committee on National Security Organization report, Vol. III, 43-44.
129. Ibid., 44; and "The Munitions Board," 10 January 1950, 7, folder Miscellaneous MB Resumes, box 89, entry 221, RG 330.
130. Memo, Ben G. Huff, Project Chief, for the Chairman, Management Committee, 13 March 1950, sub: Report on the Munitions Board Organization Study, 6, folder Organization and Functions, 1949–1950, Vol. II, box 88, entry 221, RG 330.
131. Ibid.
132. "The Munitions Board," 10 January 1950, 7.
133. Memo, Huff for Chairman, Management Committee, 13 March 1950.
134. Ibid., 2.
135. Ibid. For further discussion of the reasons for and problems associated with the frequent turnover of officers assigned to key acquisition management positions and their continuing preference over highly qualified civilian acquisition professionals, see chap. 8 in this volume, and J. Ronald Fox with James L. Field, *The Defense Management Challenge: Weapons Acquisition*, 177-269.
136. Maj. Robin Elliott, "Munitions Board Organizational History: An Analysis, as of 1 November 1949, (Prepared under the direction of Lieutenant General LeR. Lutes, U.S. Army)," 25, box 89, entry 221, RG 330.
137. Organizational Planning Division, "Functions and Organization of the Munitions Board," 17 March 1948, 2; "Organizational History of the Munitions Board," 24 August 1948, charts 3-5; National Military Establishment, *First Report of the Secretary of Defense, 1948*, 96; "MB [Munitions Board] Order No. 65 (Munitions Board Organization and Functions) 22 June 1949," copy in NDU Library; and Supply & Logistics Organizational Evolution: Major Actions, 4 September 1957, 2-4, sec. Organizational Evolution, black binder (Supply and Logistics, 1949–1959), box 954 (Assistant Secretary of Defense, Supply & Logistics, Monthly Reports & Other Documents, 1953–1958), Subject Files, OSD/HO.
138. Munitions Board Statistics Division, "Munitions Board Committees and Committee Membership," 1 June 1948, 15-20, folder Munitions Board Committees, box 100, entry 221, RG 330; Lt. Gen. LeRoy Lutes, "The Munitions Board," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 27 October 1948, 12, NDU Library;

and "MB [Munitions Board] Circular No. 8 (Procedure for Munitions Board Industry Advisory Committees) 31 January 1949," folder Reading File (Donald F. Carpenter), 15 May 1949–30 June 1949, box 122, entry 231, RG 330. At first, each committee had only a single liaison officer from the Munitions Board. Operating procedures published in January 1949 required that a government official chair any committee established after that time.

139. *First Report of the Secretary of Defense, 1948*, 95; Department of Defense, *Second Report of the Secretary of Defense for the Fiscal Year 1949*, 66; and Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30 1950*, 47.

140. Munitions Board Statistics Division, "Munitions Board Committees and Committee Membership," 1 June 1948, 17.

141. Memo, Evelyn F. Checkston [deputy chief, Committee Operations Branch] for Lt. Col. W. F. Wooldridge, 13 October 1948, sub: Information on Industry Advisory Committees, folder Munitions Board Advisory Committees, box 100, entry 221, RG 330; and Hoover Commission Committee on National Security Organization report, Vol. III, 44, 44A-44B. The Hoover Commission Committee on the National Security Organization thought the Munitions Board should make better use of its industry advisory committees.

142. Memo, Lt. Gen. LeRoy Lutes for Secretary Johnson, 5 October 1949, box 1 (Reports/Publications Re: Installations and Logistics), OSD/HO. The Hoover Commission's Committee on the National Security Organization reported: "It is difficult for the services to conceive of the Munitions Board as part of the staff of the Secretary of Defense; they tend to regard it, as they did its predecessor, the ANMB [Army-Navy Munitions Board], as their joint representative." See Hoover Commission Committee on National Security Organization report, Vol. III, 27.

143. Memo, Lt. Gen. LeRoy Lutes for Chairman, Munitions Board, 5 October 1949, tab B, to encl. to memo, Lt. Gen. LeRoy Lutes for Secretary Johnson, 5 October 1949, box 1 (Reports/Publications Re: Installations and Logistics), OSD/HO. See also Elliott, "Munitions Board Organizational History," 9-10.

144. Rearden, *Formative Years*, 32-40, 96.

145. Memo, Lutes for Chairman, Munitions Board, 5 October 1949.

146. Supply & Logistics Organizational Evolution: Major Actions, 4 September 1957, 4.

147. Tab A (Findings and Discussion), 5, to memo, Huff for Chairman, Management Committee, 13 March 1950.

148. "The National Security Act of 1947," *Department of Defense: Documents on Establishment and Organization*, 46-47 [italics added].

149. Forrestal, Report to the President, 29 February 1948, 49.

150. Elliott, "Munitions Board Organizational History," 13, 27-28.

151. Memo, Hudson B. Cox, General Counsel, for Under Secretary of the Navy, 3 June 1948, sub: Proposed Munitions Board Directive, folder Munitions Board Charter, 1948–1950, Vol. II, box 89, entry 221, RG 330.

152. Directive, Munitions Board, 9 June 1948, folder Munitions Board—Organization, 1948, box 949 (Munitions Board, 1947–1953), Subject Files, OSD/HO. See also Hoover Commission Committee on National Security Organization report, Vol. III, 36.

153. Memo, Lutes for Chairman, Munitions Board, 5 October 1949, 2-3; and Elliott, "Munitions Board Organizational History," 15.

154. Directive, (Munitions Board Charter), 3 November 1949, folder Munitions Board—Organization, 1948, box 949 (Munitions Board, 1947–1953), Subject Files, OSD/HO; and memo, M. R. McCann for Brig. Gen. E. C. Langmead, 12 January 1950, sub: General Delineation of Munitions Board Responsibilities, folder Munitions Board Charter, 1948–1950, Vol. II, box 88, entry 221, RG 330.

155. Minutes, Munitions Board meeting no. 75, 22 September 1949, box 116, entry 229 (Minutes of Meetings Relating to the Plans and Activities of the Board, Oct. 2, 1947–Jan. 1953), RG 330.

156. Memo, McCann for Langmead, 12 January 1950.

157. Tab A (Findings and Discussion), 5, to memo, Huff for the Chairman, Management Committee, 13 March 1950.
158. Minutes, Munitions Board meeting no. 2, 14 October 1947, and minutes, Munitions Board meeting no. 29, 7 October 1948 (quotation): both in box 116, entry 229, RG 330.
159. Memo, D. F. Carpenter, Chairman, Munitions Board, for Secretary of Defense, 15 March 1949, sub: Status of Purchase Assignment, folder Carpenter File, February–March 1949, box 121, entry 231, RG 330; app. to Statement of the Accomplishments of the Munitions Board in Discharging its Legal Responsibilities, 10-11, atch to memo, Cdr. D. W. Wilson [Munitions Board staff] for file, 14 April 1949, sub: Statement for Mr. Carpenter Concerning Munitions Board Programs, folder Munitions Board Accomplishments, 1949–1952, box 949 (Munitions Board, 1947–1953), Subject Files, OSD/HO; *First Report of the Secretary of Defense, 1948*, 109-10; *Second Report of the Secretary of Defense for the Fiscal Year 1949*, 87; and *Semiannual Report of the Secretary of Defense, January 1 to June 30 1950*, 45.
160. Memo, T. J. Hargrave, Chairman, Munitions Board, for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, 13 November 1947, sub: Procurement Assignment Policy, folder White File (Mr. Hargrave) Jul. 47–30 Apr. 48, box 122, entry 231, RG 330; and Munitions Board Procurement Policy Council, "Guidance to Purchase Assignment Task Committees," 13 November 1947, 4, box 104, entry 221, RG 330.
161. Memo, Powers for Chairman, Munitions Board, 12 January 1948; and memo, T. J. Hargrave for Secretary of Defense, 21 January 1948, sub: Status of Purchase Assignment, folder White File (Mr. Hargrave) Jul. 47–30 Apr. 48, box 122, entry 231, RG 330.
162. Hoover Commission Committee on National Security Organization report, Vol. III, 48.
163. Memo, T. J. Hargrave, Chairman, Munitions Board, for Secretary of Defense, 12 May 1948, folder White File (Mr. Hargrave) Jul. 47–30 Apr. 48, box 122, entry 231, RG 330.
164. Memo, Lt. Gen. LeRoy Lutes, Director of the Staff, for Directors and Division Chiefs, 31 August 1948, sub: Criticisms Made Before Eberstadt Committee, folder Hoover Commission (Eberstadt Committee), box 88, entry 221, RG 330.
165. Minutes, Munitions Board meeting no. 70, 18 August 1949, box 116, entry 229, RG 330.
166. Margulis and Yoshpe, *National Security Management: Procurement*, 7.
167. Memo, Carpenter for Secretary of Defense, 15 March 1949; and Single Procurement Program: Plant Cognizance, 2, History of Procurement Assignment, 17 January 1957.
168. Lutes, "The Munitions Board," 27 October 1948, 15.
169. Single Procurement Program: Plant Cognizance, 3, History of Procurement Assignment, 17 January 1957.
170. Ibid., 2.
171. Rearden, *Formative Years*, 328, 331, 333.
172. Ibid., 278-82, 313-18. For a provocative interpretation that emphasizes the influence of the aircraft industry and other segments of business and finance in bringing about aircraft procurement increases, and that also challenges the notion American leaders were concerned about the prospect of imminent Soviet military action in Europe, see Frank Kofsky, *Harry S. Truman and the War Scare of 1948: A Successful Campaign to Deceive the Nation*, rev. ed. For a sharply contrasting, and generally standard, interpretation of U.S. officials' perception of Soviet intentions in Europe, see Daniel Yergin, *Shattered Peace: The Origins of the Cold War and the National Security State*, rev. ed., 343-60.
173. Rearden, *Formative Years*, 212-13, 315.
174. Memo, Lt. Gen. LeRoy Lutes for Secretary of Defense, 3 February 1948, sub: Comments on Aircraft Situation [Stamped "Secret," this memorandum is filed in a brown envelope marked "Programs of AF & Navy" and bears the logo of the Aircraft Industries Association], box 2, entry 210, RG 330. In drafting the memorandum for the secretary of defense, it is likely that Lutes drew on a study then in preparation but not completed until 10 February 1948 (the conclusions are the same). See memo, Brig. Gen. Alfred A. Kessler, Jr., Chairman, Aircraft Committee, Munitions Board, for Munitions Board, 10 February 1948, sub: Impact on

Industry of Long Range Aircraft Manufacturing Program, folder Aircraft Appropriation and Procurement, box 1, entry 210, RG 330. Kessler, an Air Force officer, chaired the committee, but was from Air Force headquarters and not from the permanent Munitions Board staff.

175. Rearden, *Formative Years*, 320.

176. Memo, Lt. Gen. LeRoy Lutes for Mr. Forrestal, 31 March 1948, sub: Air Programs, folder Aircraft Appropriation and Procurement, box 1, entry 210, RG 330; ltr, James Forrestal to General Echols, 6 April 1948, folder Aircraft Committee, Munitions Board, box 1, entry 210, RG 330; minutes, Munitions Board meeting no. 13, 15 April 1948, box 116, entry 229, RG 330; ltr, Lt. Gen. LeRoy Lutes, Deputy Chairman, Executive Committee, Munitions Board, to Secretary of the Navy [a nearly identical letter was sent to the secretary of the Air Force], 22 April 1948, folder Aircraft Committee, Munitions Board, box 1, entry 210, RG 330; and minutes, Munitions Board meeting no. 14, 29 April 1948, box 116, entry 229, RG 330. In his letter to Echols, Forrestal wrote: "I believe the time has come to coordinate all the aircraft requirements of the Army, Navy and Air Force into one joint pattern, so that they can be studied from the standpoint of priority, plants, critical raw materials, machine tools, Government furnished property and very possibly, finance. These functions are similar to those performed during the war by the Joint Aircraft Committee, of which you were a member."

177. Memo for record, Col. Lawrence B. Ocamb, 6 April 1948, folder Aircraft Committee, Munitions Board, box 1, entry 210, RG 330.

178. Transcript of meeting, 9 April 1948, 3-4 (quotation), 5, box 398, entry 323 (Minutes of Meetings and Agenda of the Aircraft Committee, 1947–1952), RG 330. The number of aircraft in a combat group varied depending on aircraft type. See chap. 5, note 7.

179. Ltr, Lutes to Secretary of the Navy, 22 April 1948; and memo Rear Adm. A. M. Pride, Chairman, Munitions Board Aircraft Committee, for Chairman, Munitions Board, 16 April 1948, sub: Impact on Industry of Long Range Aircraft Manufacturing Program, attaching memo, Maj. Gen. Frederick M. Hopkins, Jr., Chief, Industrial Mobilization Division, Headquarters, Air Materiel Command, for Chairman of the Aircraft Committee, Munitions Board, 14 April 1948, sub: Impact on Industry of Combined Navy–Air Force Building Programs, Plan I and Plan II, unmarked folder, box 2, entry 210, RG 330. Among the production difficulties the report identified were obtaining certain alloys (cobalt, columbium, chromium), eliminating "peaks and valleys" in production schedules and the associated manpower fluctuations, and generating sufficient electric power to produce aluminum.

180. Transcript of meeting, 9 April 1948, 15-20.

181. Munitions Board Order No. 142 (Munitions Board Aircraft Committee), 15 April 1948, folder Aircraft Committee, Munitions Board, box 1, entry 210, RG 330.

182. Minutes, Munitions Board meeting no. 19, 22 July 1948, box 116, entry 229, RG 330; Presentation of Munitions Board Programs and Funds to the Joint Chiefs of Staff, 7 September 1948, sec. 8, 2-4, box 99, entry 221, RG 330; and minutes, Aircraft Committee meeting no. 32, 19 April 1949, box 400, entry 323, RG 330.

183. Agenda, Aircraft Committee meeting no. 15, 23 July 1948, box 398, entry 323, RG 330. In addition to "working" and "planning" schedules for current procurement, the committee also prepared mobilization schedules for wartime procurement.

184. Agenda, Aircraft Committee meeting no. 11, 11 June 1948; minutes Aircraft Committee meeting no. 13, 25 June 1948; and minutes Aircraft Committee meeting no. 19, 21 September 1948: all in box 398, entry 223, RG 330; Presentation of Munitions Board Programs and Funds to the Joint Chiefs of Staff, 7 September 1948, sec. 8-3; Lutes, "The Munitions Board," 27 October 1948, 10; and minutes Aircraft Committee meeting no. 25, 21 December 1948, box 399; minutes, Aircraft Committee meeting no. 32, 19 April 1949, box 400: both in entry 323, RG 330.

185. Minutes, Aircraft Committee meeting no. 41, 20 September 1949, box 401, entry 323, RG 330.

186. Munitions Board Survey Team Report, "Procurement of Aircraft," January 1950, 1-6, and

app. 1, copy in NDU Library.
187. Munitions Board, Purchase Assignment Division, Office of Procurement Methods, "Effectiveness of Military Procurement Methods," April 1950, 1-2, 9-11, 41-43, 45, copy in NDU Library; and History of Procurement Assignment, 17 January 1957, 9-10.
188. Minutes, Munitions Board meeting no. 65, 14 July 1949, box 116, entry 229, RG 330. The board had requested $160 million.
189. Memo, Lutes for Secretary Johnson, 5 October 1949, 2.
190. Tab B (Logistic Unification), 9, to encl. to memo, Lutes for Secretary Johnson, 5 October 1949.
191. Ltr, Stratton to Compton, 14 February 1949, 7.

I. Sources: Glen R. Asner, "Industrial College of the Armed Forces," Paper prepared for the Defense Acquisition History Project, 2004; Ralph Sanders and Theodore W. Bauer, *In Quest of Excellence: The Industrial College of the Armed Forces*; and "ICAF History," National Defense University, Industrial College of the Armed Forces, http://www.ndu.edu/icaf/about/history.htm (retrieved on 6 June 2011).

II. Sources: Glen R. Asner, "Lieutenant General LeRoy Lutes," Paper prepared for the Defense Acquisition History Project, 2004; Vannevar Bush, "Organization for Research and Development," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 21 November 1947, 11 (quotation), folder 5 (120/RDB), box 28, entry 341, RG 330; "Munitions Board Executive," *Army Information Digest* 3, no. 8 (August 1948); "Lieutenant General LeRoy Lutes," October 1949, Press Branch, Office of Public Information, Department of Defense, 1-2 (copy in Lutes biographical file, U.S. Army Center of Military History library and archives, Fort Lesley J. McNair, Washington, D.C.; and John Kennedy Ohl, *Supplying the Troops: General Somervell and American Logistics in WWII*, 65, 199-201, 229 ("cool and efficient" quotation).

CHAPTER III

The Response to War: OSD and Acquisition, 1950–1953

Moving south across the 38th parallel, North Korean forces started the Korean War on 25 June 1950. Before the armistice was declared three years later, the United States had accomplished a huge military buildup that more than doubled the size of the armed forces. When the war began, the U.S. military numbered just over 1.5 million personnel, comprising an Army of nearly 600,000, including 10 divisions, almost all under strength; a Navy of 238 major combat vessels; a Marine Corps of 2 under-strength divisions; and an Air Force of 48 wings.[1] By June 1953, the number of Army divisions had doubled to 20; the Navy possessed 409 major combatants; the Marine Corps had 3 divisions; and the Air Force boasted 106 wings. In all, more than 3.5 million personnel were in uniform.[2] In the five fiscal years, 1946–1950, over $91 billion had been spent on defense (about 45 percent of total federal spending for those years), almost half for liquidating the costs of World War II.[3] But during the three years of the Korean War (FYs 1951–1953), Defense Department expenditures were more than $122 billion, nearly two-thirds of total federal spending of just over $189 billion.[4] Of the Defense Department's $122 billion, almost $50 billion represented the value of "hard goods": the aircraft, ships, tanks, electronic systems, and other types of equipment, as well as ammunition needed by the services. ("Soft goods" included subsistence, primarily food; fuels and lubricants; and clothing.)[5]

In World War II, the Army and Navy had dealt independently with the War Production Board and other government agencies directing the mobilization of national resources. During the Korean War, the secretary of defense exercised policy direction over the military's rearmament and served as the armed forces' point of contact with the executive branch agencies established to manage the mobilization. This chapter assesses the performance of the Office of the Secretary of Defense in those roles—specifically the parts played by the secretary and his staff, the Joint Chiefs of Staff, the Munitions Board, and the Research and Development Board.

Although the military buildup was surely successful in terms of increasing military strength, OSD was plagued by organizational weaknesses and failed to manage it efficiently. Revelations of shortcomings in procurement planning and production resulted in pressures for change, mostly coming from outside the Defense Department. OSD adopted some of the suggestions made by critics but resisted others. Ultimately, the problem-ridden management of acquisition during the Korean War became an important factor in the major reorganization of the Defense Department that took place in 1953 under the administration of President Dwight Eisenhower.

REARMAMENT: PURPOSES AND ORGANIZATION

Mobilization Objectives

The Truman administration's rearmament program responded to much more than the needs of the Korean War; the war's direct costs absorbed no more, and were probably less, than an average of $18 billion annually of Defense Department outlays that averaged about $41 billion during each of FYs 1951–1953.[6] The buildup had a larger purpose: to meet what many believed to be an increasing threat, particularly in Western Europe, from the Soviet Union and communism. In early 1950, following the detonation of the first Soviet atomic bomb in August 1949, the Communist takeover in China that October, and evidence that the Soviets had gained access to information about the U.S. hydrogen bomb project, President Truman ordered a complete review of national security policy. Conducted by a special State Department and Defense Department team, the review resulted in a proposed new policy embodied in National Security Council paper 68, dated 14 April 1950.[7] The paper reaffirmed the validity of the administration's containment strategy but also called for substantial strengthening of "free-world" political, economic, and military capabilities. With respect to the latter, NSC 68 projected a need for sharp increases in U.S. conventional military forces that would likely raise Defense Department spending from the $13 billion appropriated for FY 1951 to as much as $40 billion annually. Concerned about the program's cost and impact on the economy, Truman had not yet approved NSC 68 in June 1950. The North Korean attack decided the matter.[8]

The authors of NSC 68 did not believe the Soviet Union was preparing to launch an attack in the near future, but they thought a war might start accidentally. They also expected that the Soviets would have produced enough atomic bombs by 1954 to inflict serious damage on the United States. Thus, the National Security Council believed that the nation must complete a substantial military buildup by that year, the year of greatest danger.[9] On 14 December 1950, based on recommendations from the JCS and after a lengthy debate within the administration, President Truman approved force-level objectives to go along with the policy articulated in NSC 68.[10] The goals were a total of 3.2 million personnel; an Army of 18 divisions; a Navy of almost 400 major combat vessels, 14 carrier air groups, and 2⅓ Marine Corps divisions; and an Air Force of 95 wings. Communist China's intervention in the Korean War at the end of November 1950, however, had made a dangerous situation more threatening, and the president decided that the time for achieving the force levels should be accelerated from 1954 to mid-1952. Two days after approving the increased force levels, Truman declared a national emergency. He told the American people of the plans for rearmament, his intention to impose selective wage and price controls, and the creation of the Office of Defense Mobilization to coordinate the administration's mobilization effort.[11]

In contrast to the all-out mobilization of World War II, Truman decided to meet the materiel demands of the hot war in Korea and the larger Cold War confrontation with a "partial" or limited mobilization that could achieve NSC 68's objectives without major disruption to the civilian economy. Indeed, the administration planned to continue expanding the economy while placing as few controls on it as possible, thereby establishing a foundation for military production that could be increased at will.[12] Retired General of the Army George C. Marshall, who had succeeded Louis Johnson as secretary of defense in September 1950, explained the administration's mobilization policy in testimony before the Senate Appropriations Committee in December. "This is a move," said Marshall, "to place us in a strong position from which we can go forward rapidly to the extent necessary. This is not full mobilization. This is a raising up of the whole establishment to gain momentum from which we can open the throttle and go very quickly in any required direction."[13] The secretary of defense thus articulated the concept of the permanent mobilization base. Advocated by many since the end of World War II and now to be implemented during the Korean War, the maintenance of a permanent mobilization base would anchor defense planning and preparedness for decades to come.[14]

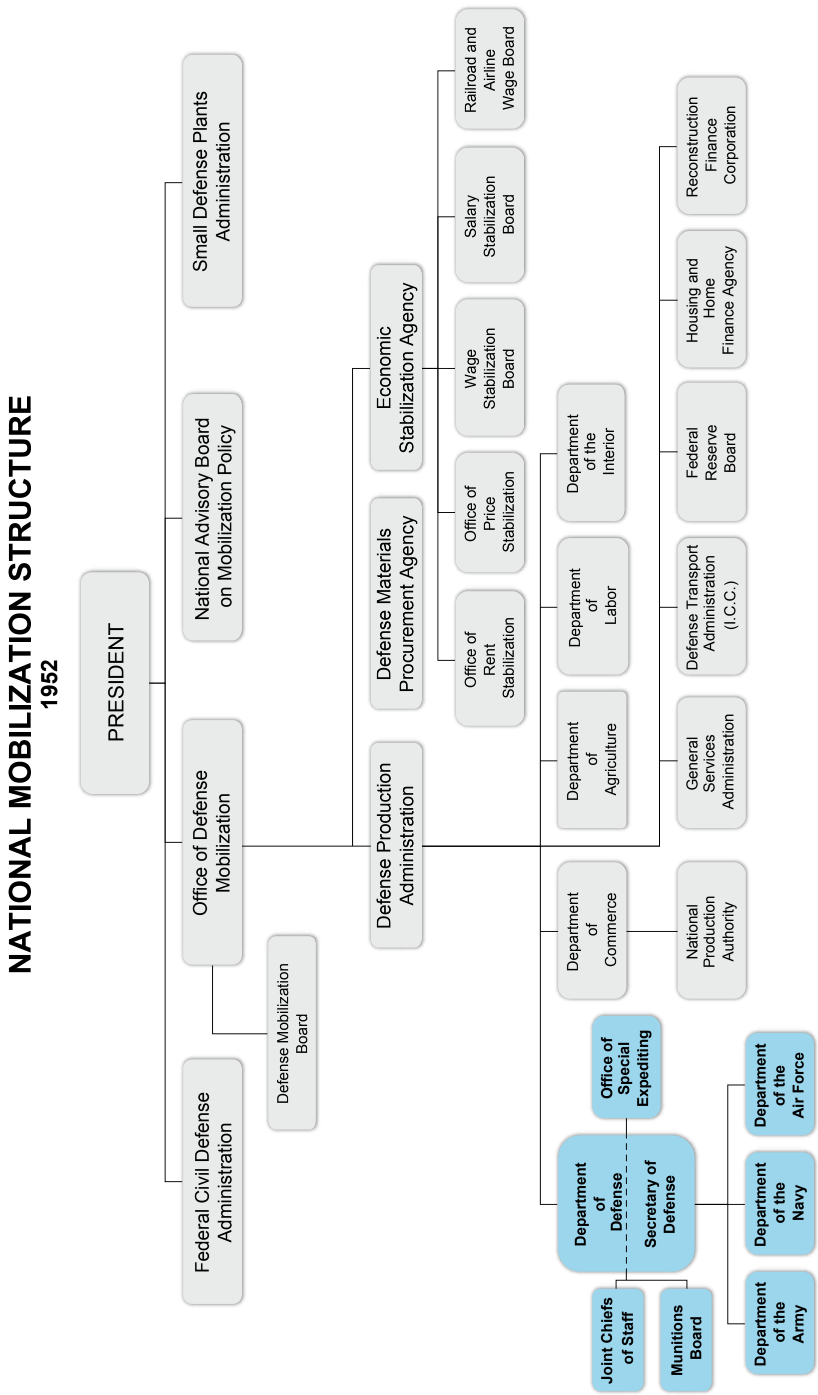
Partial mobilization was designed to fulfill several specific production objectives: first and most immediate, to supply and equip the forces fighting in Korea; second, to expand and modernize the armed forces to achieve the force goals outlined in NSC 68; third, to support military assistance programs to other nations, particularly to the U.S. partners in NATO. A final short-term objective was to accumulate reserve stocks of key items sufficient to wage total war for a year. Partial mobilization's long-range purpose—creating a productive capacity able to support total war for an extended period—entailed acquiring a stockpile of critical materials, developing production lines for military goods in addition to those meeting shorter-term materiel requirements, and expanding basic industries that could support both civilian and military needs.[15] Government incentives for industry, such as accelerated tax amortization, loans, subsidies, pool orders, guaranteed markets, and antitrust law exceptions, would help to achieve this long-range goal.[16]

Left to right: President Truman, Secretary of Defense George C. Marshall, and his successor, Robert A. Lovett.

The National Mobilization Structure

The Truman administration's organization for managing the mobilization evolved gradually in two major phases.[17] After the war began, the president relied at first on the National Security Resources Board to advise him and to coordinate the government's mobilization of materiel. Chaired in June 1950 by former Secretary of the Air Force W. Stuart Symington, the board was a high-level interdepartmental body created by the National Security Act of 1947. In theory, it was to have the same relationship to resource management in wartime that the National Security Council had with respect to the formulation of overall security policy. By December 1950, however, Truman had lost confidence in the National Security Resources Board, considering it incapable of managing the expanded effort necessary to achieve NSC 68's force levels.[18]

In conjunction with his declaration of a national emergency, the president's announcement that he was establishing the Office of Defense Mobilization (ODM) was the first step in overhauling the administration's mobilization management structure. Directly under the executive office of the president, the Office of Defense Mobilization was responsible for formulating policy and coordinating mobilization activities throughout the executive branch.[19] Truman delegated wide-ranging power to its first director, Charles E. Wilson, president of General Electric. Often called "Electric Charlie" (to distinguish him from another Charles E. Wilson—"Engine Charlie" the president of General Motors



Source: Adapted from chart (Chain of Command)," in U.S. Congress, Joint Committee on Defense Production, *Defense Mobilization Organization*, 12 August 1952, 3.

and later Eisenhower's first secretary of defense), Wilson had been executive vice chairman of the War Production Board during World War II and was well qualified for the new post.[20] To provide Wilson advice regarding mobilization policy, the Defense Mobilization Board, another new body composed primarily of cabinet members, including the secretary of defense, was established.[21]

Charles E. Wilson, director of the Office of Defense Mobilization, 1950–1952.
Courtesy, Schenectady Museum and Suits-Bueche Planetarium.

To develop policy and operate essentially as the Office of Defense Mobilization's staff arm, Wilson created the Defense Production Administration (DPA). Its principal functions were to determine production priorities, the feasibility of production programs, production quotas, and the scope of industrial expansion.[22] In short, the agency weighed proposed military programs against the total of national resources to see if the programs could be achieved, and then divided the resources between civilian and military needs. At the Defense Mobilization Board's first meeting, Wilson suggested that the Defense Production Administration should also be tasked to determine "*for all agencies, production plans, methods, procedures.*" Secretary of Defense Marshall and retired General Lucius Clay, Wilson's deputy at the Office of Defense Mobilization and formerly American military governor in postwar occupied Germany, opposed granting this added authority to the Defense Production Administration and recommended that the wording be changed to: "*secures* production plans *from* all agencies and develops methods and procedures for their execution." Subsequently adopted, the revision effectively blocked the DPA from becoming directly involved in the preparation of the military services' production programs.[23]

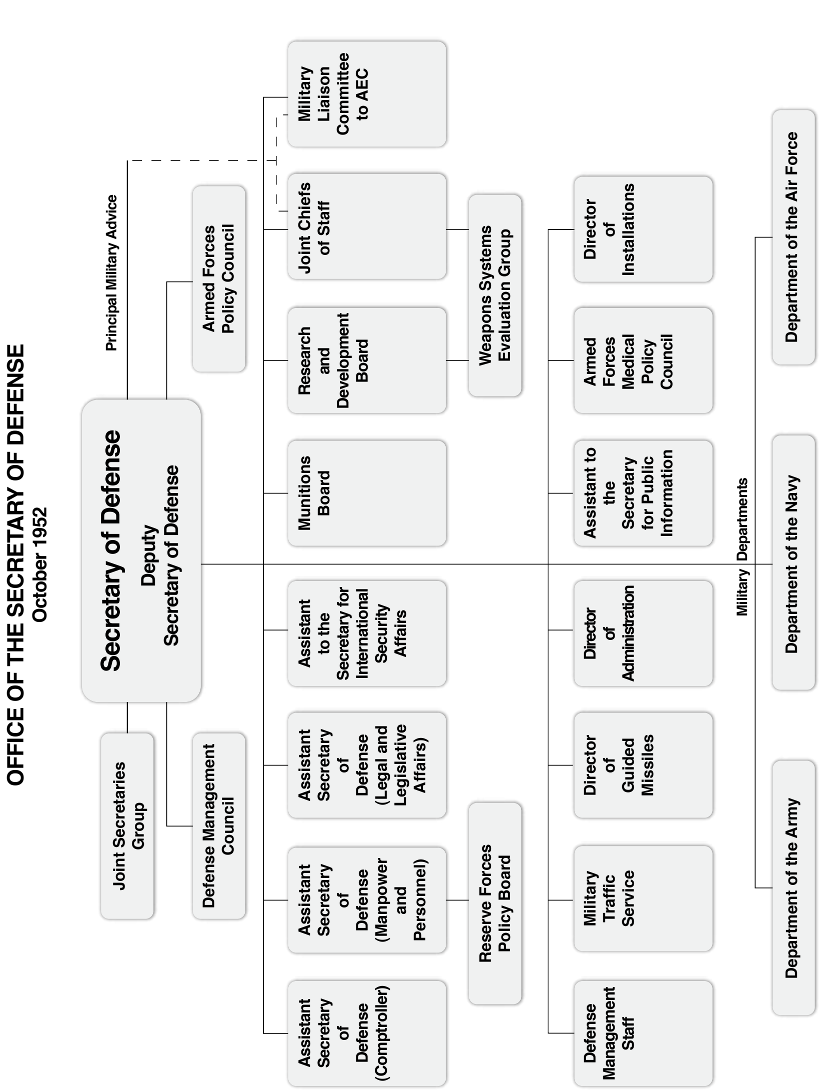
Several specialized agencies, subordinate to the Office of Defense Mobilization and many already part of existing government departments, had operational responsibilities and administered various day-to-day aspects of the mobilization. With respect to industrial production, the most important of these after the Defense Production Administration was the National Production Authority (NPA), established as part of the Commerce Department in September 1950. With the reorganization of mobilization management, the NPA yielded some of its responsibilities, particularly priority and allocation authorities, to the Defense Production Administration, but it continued to operate systems for controlling the allocation of critical materials such as steel, aluminum, copper, and some scarce metals, particularly alloys. These regulating mechanisms included the Defense Order rating system and, beginning in July 1951, the Controlled Materials Plan.[24]

Organization for Mobilization in OSD

The Office of the Secretary of Defense, in contrast to other parts of the executive branch, did not immediately make any significant organizational changes related to mobilization and the acquisition of materiel. To assist in providing policy direction for and management of the Department of Defense's rearmament program, the secretary of defense relied on the Joint Chiefs of Staff and the Munitions Board. By the summer of 1951, the production of hard goods was well short of what many expected, and both the mobilization agencies and Congress had begun to criticize OSD's management of rearmament. In early 1952, under pressure to address production bottlenecks, the secretary of defense named a special assistant to head a newly created office in OSD to expedite the Defense Department's mobilization effort. It succeeded in overcoming some of the deficiencies in the existing organizational structure.

Three secretaries of defense led the department during the Korean War. Louis Johnson, secretary since the spring of 1949, was at the helm in June 1950. Unpopular with almost everyone because of his arrogant and abrasive manner and regarded as overzealous in holding down defense spending, Johnson was scapegoated by the press and others for the military's lack of preparedness in Korea. In September 1950, President Truman fired Johnson, by then a political liability, and nominated General Marshall to replace him. Marshall, the Army's chief of staff during World War II ("the organizer of victory") and secretary of state from early 1947 to early 1949, was respected by nearly everyone, except some in the Republican Party who blamed him for the "loss" of China. But in September 1951, after only a year as secretary of defense, the seventy-year old Marshall, weary after decades of government service, resigned. Robert A. Lovett, a banker who had been assistant secretary of war for air during World War II, under secretary to Marshall at the State Department, and now Marshall's deputy at the Defense Department, moved up to become secretary and served in the post until the change of administrations in January 1953.[25]

In directing a rearmament program that involved the acquisition of tens of billions of dollars of equipment, the secretary of defense depended primarily on the advice of the Joint Chiefs of Staff.[26] Indeed, the Joint Chiefs' recommendations to the secretary regarding force levels—for numbers of divisions, major combat ships, aircraft wings, and total personnel strengths—initiated the acquisition process. Following approval of these force levels, first by the secretary of defense, then by the National Security Council, and finally by the president, the services translated the figures into programs for specific "end items" (e.g., types and numbers of aircraft, ships, and tanks). In the next stage of the acquisition process, the office of the OSD comptroller, headed from the first days of unification by



Source: Adapted from Chart 5 (Office of the Secretary of Defense, 15 October 1952), in Trask and Goldberg, *The Department of Defense, 1947–1997*, 19.

Wilfred J. McNeil, reviewed the services' programs to see that they conformed to budget guidelines that had been provided by the White House. They were then submitted, in turn, to the secretary of defense, the Bureau of the Budget, the president, and Congress. Once Congress appropriated funds, the services could conclude contracts with manufacturers to produce the programmed end items.[27]

Wilfred J. McNeil, assistant secretary of defense (comptroller), 1949–1959.

Wilfred J. McNeil (1901–1979)

Throughout the Truman and Eisenhower administrations, the Office of the Secretary of Defense influenced acquisition primarily through control of the services' budgets. From 1947 through 1959, Wilfred McNeil served as OSD's comptroller, with the rank of assistant secretary of defense after 1949. But, in addition to overseeing the department's budget, accounting, reporting, auditing, and fiscal activities, McNeil, who possessed extensive knowledge of service programs and maintained the confidence of a succession of defense secretaries, also played a key role in decisions regarding the establishment of force levels and funding for specific weapon systems.

Born and raised in Iowa, Wilfred McNeil did not complete high school or attend college. What he lacked in formal education, he more than made up in his ability to seize opportunities and to build upon his experiences and personal connections. Following service in the Naval Reserve during World War I, McNeil came home to work in his father's bank. In 1923, he became president of a bank in Colorado, returning to Iowa three years later to run a Nash automobile distributorship. In the late 1920s, he entered the newspaper circulation business, first with the *Des Moines Register and Tribune*, and, beginning in 1934, with the *Washington Post*. In June 1941, McNeil applied for and was recalled to active duty in the Navy and assigned as the department's deputy disbursing officer, a job that he later admitted he was "entirely unqualified for" (despite approximately 20 years of business experience). He had secured the post at the request of the Navy

Department's disbursing officer, the last officer McNeil had served under during World War I. In less than a year, his mentor was reassigned and McNeil succeeded him. In December 1944, Secretary of the Navy James Forrestal asked McNeil, by then a rear admiral, to serve as the Navy's fiscal director. Since this was a civilian position, McNeil was released from active duty.

When Forrestal became the first secretary of defense in September 1947, McNeil, who had become the Navy secretary's administrative assistant, went with him. During the next two years, as one of the three special assistants authorized the secretary of defense under the National Security Act, McNeil functioned as the National Military Establishment's comptroller. He was sworn in as an assistant secretary of defense in September 1949, with Secretary of Defense Louis Johnson formally designating him the comptroller of the Department of Defense.

McNeil's power was known up and down the military establishment. In 1957, during the question and answer period following a speech by Clifford C. Furnas, former assistant secretary of defense for research and development, at the Industrial College of the Armed Forces, an audience member commented: "We are all familiar with the ability of Mr. McNeil to control service project areas through his funding limitations." Such clout and McNeil's prior service in the Navy generated suspicion. In an interview after his retirement, General J. Lawton Collins, Army chief of staff from 1949 to 1953, stated that he and other Army leaders believed McNeil to have been slightly biased in favor of the Navy, and desirous of setting up a chain of command of military department comptrollers that would have bypassed the service secretaries and uniformed chiefs.

McNeil's bias was not in the direction of one service or the other, but toward enhancing the power of the secretary of defense and the efficiency of the Defense Department through the establishment of uniform budgetary and fiscal procedures for the institution. Steven Rearden, author of the inaugural volume in the *History of the Office of the Secretary of Defense* series, suggests that this may have been McNeil's greatest achievement in 12 years as comptroller.

After leaving the Department of Defense in 1959, McNeil served as president of Grace Line, Inc., a steamship company and subsidiary of W. R. Grace & Co., from 1959 to 1967. He died in 1979 and is buried in Arlington National Cemetery, in the shadow of the Pentagon, alongside his wife and one of his two sons, both military officers.[1]

In contrast to the Joint Chiefs of Staff, the Munitions Board had virtually no role in the acquisition process for the services' current procurement programs. Secretary of Defense Forrestal's original vision for the board—that it should be responsible for "all industrial matters with which the Armed Services are concerned"—never materialized. When the Korean War began, the Munitions Board's major responsibilities included developing policy for the military's part in industrial mobilization planning for total war, administering the national strategic stockpile of critical raw materials, turning out new sections of the Armed Services Procurement Regulation, and producing a standard catalog of items used by the services.

The nature and scope of the Munitions Board's activities had been restricted because the services wanted to keep OSD from interfering in "operational" matters, particularly the development of their acquisition programs. The services could tie the board's hands because they controlled its organizational structure. In addition to the chairman, who had been appointed by the president from the private sector, the board's members included a civilian under or assistant secretary from each military department who were both advocates and judges of their own service's positions and programs. Although the 1949 amendments to the National Security Act made it possible for the chairman to cast the deciding vote on issues being considered by the board—even when all three of the military department representatives were in agreement—Secretary of Defense Johnson limited the chairman's authority to only those instances when the service members were not unanimous.

Another reason for service dominance of the Munitions Board was that for most of its short history, the board's chairmanship was not filled by either long-serving or strong leaders. Hubert Howard, the board's third chairman, had been on the job for about six months in June 1950. He proved no more inclined to challenge the services than his two predecessors, Thomas Hargrave and Donald Carpenter, and his tenure was similarly brief. In mid-September 1950, one day following Secretary Johnson's resignation, Howard left the board. After Korea erupted, Sen. Lyndon B. Johnson (D-Tex.), chairman of the Preparedness Investigating Subcommittee of the Senate Armed Services Committee, began looking into Munitions Board activities. He was planning to hold hearings on alleged deficiencies in the national stockpile of critical materials and had criticized the board publicly. According to Leonard Niederlehner, the Munitions Board's general counsel, Howard "figured that he didn't have to put up with it at his stage of life and he resigned."[28]

The appointment of John D. ("Jack") Small as chairman in November 1950 finally gave the Munitions Board the strong leader it needed. A graduate of the Naval Academy (Class of 1915), Small had spent eleven years in the Navy and then entered the business world. During World War II, he had been chief of staff to the chairman of the War Production Board. When appointed Munitions Board chairman, he was vice president of Emerson Radio & Phonograph Corporation.[29]

John D. Small, chairman of the Munitions Board (seated, second from left) with members of board and staff, November 1952.

In contrast to his predecessors, Small had a relatively long tenure, remaining in the post until January 1953. Like Lieutenant General Lutes in the late 1940s, Small attempted to make the board an instrument of OSD rather than the tool of the services that it had largely been prior to his appointment.

Small's efforts to reorient the board met some success. Although the services remained firmly in control of their procurement programs, the responsibilities and influence of the Munitions Board chairman and staff increased during the rearmament. On behalf of the secretary of defense, the board represented the military departments to the mobilization control agencies—ODM, DPA, and NPA—and presented their claims for material resources. In mid-1951, to bring about the integrated procurement planning and execution being demanded by President Truman and Congress, Secretary Lovett made the board responsible for reviewing the validity of materiel requirements and put controls on the services' acquisition programs that had not existed before. In July 1952, giving in to pressure from nearly every quarter (except from the services), Lovett granted the chairman the power to make the final decision—whatever the position of the department members—on all matters under the board's jurisdiction.[30]

The expansion of the Munitions Board's role and the increase in the power of its chairman notwithstanding, critics from within and outside the administration judged OSD to be mismanaging the Defense Department buildup. They pointed to poorly conceived estimates of military requirements for materials and unrealistic production schedules, insufficient attention to causes of production delays, and an inability to establish priorities among competing service programs.

REQUIREMENTS ESTIMATES AND PRODUCTION SCHEDULES

Despite shortages of materials, mobilization control agency officials hoped both to satisfy military needs and to minimize disruption to the economy. Accurate estimates of the services' requirements for materials and realistic production schedules were crucial to achieving these two objectives. Edwin T. Gibson, acting administrator of the Defense Production Agency, emphasized this point in a lecture at the Industrial College of the Armed Forces in May 1951: "While all of us want to meet the military requirements fully and on schedule, we don't want the defense effort to get out of balance, with the consequence that businesses are forced to the wall, that civilian goods are found lacking, that prices skyrocket, and that inflation becomes even more menacing than an outside enemy. Because of these considerations we have to begin our efforts for defense by planning as carefully and as well as the responsibility placed on the planners demands."[31]

Estimating requirements for materials and designing production schedules were difficult and complex tasks. The military departments first determined the number and type of end items to be acquired—for example, the total of M47 Patton medium tanks—to achieve targeted force levels with the funds expected to be available. With information provided in part by manufacturers, the services then translated those figures into quantities of materials needed for production—in the case of tanks, these were steel, aluminum, copper, and scarcer materials such as nickel and tungsten. Again, working closely with contractors, the services then drew up time-phased production schedules that attempted to mesh delivery dates desired by the services with plant manufacturing capabilities. The Munitions Board then forwarded the military department estimates of requirements for raw materials and the production schedules to the mobilization control agencies for resource allocation.

All of this took place as funding levels and projected force sizes changed rapidly and frequently. Between the end of September 1950 and the end of May 1951, Congress made three supplemental appropriations to the Defense Department's FY 1951 budget.[32] In October 1951, less than a year after approving the force levels recommended for FY 1952, the president approved an increase in planning for the FY 1953 budget. Although the new targets called for the Navy to grow by only a handful of major combat vessels (from 397 to 408), the number of Army divisions was projected to climb from 18 to 21. In a reflection of the Air Force's growing importance in national security strategy, the expansion planned for that service was spectacular—from 95 to 143 wings. Three months later, however, the president, for several reasons but mostly because he feared that increased defense spending would damage the economy, abruptly reversed course and decided to "stretch out" the buildup over several years.[33] Such fluctuations, of course, made calculating requirements a continuous exercise.

Military agencies charged with estimating requirements and drawing up schedules faced other obstacles. Calculating requirements took time and much of the work was done manually; the services were only beginning to apply computers and more advanced statistical analysis techniques to the task. Also, the number of personnel trained in requirements computation had declined sharply since World War II.[34]

The complexities of requirements planning notwithstanding, criticism of the Defense Department in this area was persistent in 1951 and 1952. During his presentation at the Industrial College of the Armed Forces in May 1951, Acting DPA Administrator Gibson, in response to a question from the audience about allegations of poor requirements estimates from the armed forces, stated bluntly: "[A]t the expense of hurting someone's feelings, I don't think they are very accurate."[35] Production schedules also came under fire. A report issued by Senator Johnson's Preparedness Investigating Subcommittee in 1952 pointed out that "Not a single aircraft schedule was checked in detail for feasibility [whether it could be met] with the Defense Production Administration until July 26, 1951—13 months after [the Korean War started]."[36]

The first real indication that the Defense Department's system for estimating material requirements might be wanting—at least the first that could not be ignored—had come in a memorandum of 3 November 1950 to President Truman from Bureau of the Budget Director Frederick J. Lawton. In a "quick" assessment of the procedures used by the services to translate end items into quantities of materials, the bureau had found a "major gap" in the system. "Above the technical level of computation—that is, at the military department level or in the Munitions Board," Lawton told the president, "there does not appear to be any strong notion of responsibility for a critical review and sound evaluation of material requirements." To correct the deficiency, he recommended revising organizational structures and strengthening the staffs of both the military departments and the Munitions Board to provide for adequate oversight. The Munitions Board especially, in his view, needed more qualified civilians in supervisory positions to provide continuity and expertise. Staff and organizational changes would help "make effective its role both as a review and subsequently as a claimant agency for materials required by the military."[37]

At the bottom of Lawton's memorandum, the president wrote: "To the Secretary of Defense—I hope you will consider the suggestions in this paper and take such action as you deem necessary." On 6 November, Secretary Marshall sent the letter to the Munitions Board for action.[38] Ten days later Jack Small was sworn in as Munitions Board chairman. With the requirements problem in his lap, Small responded quickly to one of Lawton's recommendations. He obtained approval in early January 1951 for a reorganization of the board that put civilians with business experience in all five key staff positions (in place of the three military officers who had headed the board's three directorates under its old organizational structure).[39] He would later find out that dealing with the military departments regarding requirements estimates and production schedules would prove to be a much more difficult proposition.

To address further the problems identified by the Bureau of the Budget, the Munitions Board staff proposed that the chairman seek an expansion of his authority, including the unrestricted power of decision in matters before the board, and that the staff be organized and augmented to perform aggressive review of the services' programs. "In obtaining the military share of the nation's resources," stated the staff analysis, "the Secretary of Defense must have firm, realistic and coordinated knowledge of military requirements. This knowledge can be secured only by a staff agency of the Secretary of Defense equipped with adequate authority and technical competence to independently assess the demands of the military departments."[40]

The record does not reveal whether Small went to the secretary of defense with a request for increased authority at this time. It does not seem likely; he had been on the job less than two weeks before being presented with the staff proposal. Before making additional changes, Small sought the advice of outside experts. In January 1951, he commissioned the Harvard Business School to review the Defense Department's methods, procedures, and organization for determining material requirements.[41]

Completed at the end of March 1951, the four-volume Harvard study (one covering the Munitions Board and one for each of the services) identified numerous problems and suggested many corrective measures. It noted that a chief weakness of the military establishment's requirements planning—a deficiency also pointed out by the Bureau of the Budget and in the Munitions Board staff study—was the lack of program guidance from the Joint Chiefs of Staff that extended any further than the next fiscal year (in this instance, FY 1952). The absence of such direction, according to the Harvard analysis, "makes end-item requirements and planned procurement schedules (and therefore raw materials requirements) which are forecasted over two years ahead, almost completely useless." Among the report's key recommendations was that the Munitions Board should participate in the budget review process "with the top reviewing committees at the Office of the Secretary of Defense level." Another was for the military departments to be required to link estimates for quantities of materials directly to specific production schedules.[42]

Before the Harvard study could be fully assessed, President Truman intruded into the requirements arena for the second time—this time demanding action. On 26 April 1951 the president sent a special message to Congress requesting extension of the Defense Production Act and the authority to place tighter controls on the economy.[43] The next day he summoned the top officials in the administration involved in managing the rearmament program to the White House. He reminded them of his belief that inflation was mobilization's major enemy. In view of the $34.7 billion requested for military hard goods in the FY 1952 budget that he was about to transmit to Congress (along with the $27 billion already available from FY 1951), the president thought everyone in the administration had an especially heavy responsibility "to see that we buy wisely." Truman said he did not think the Defense Department was organized to do this properly and needed to adopt tighter controls over procurement.[44]

To increase the Defense Department's ability to manage procurement, the president told the assembled officials that he was directing it, cooperating closely with the mobilization agencies, to take several steps. First, he ordered the department to establish "specific, realistic production schedules covering items comprising at least 70–75 percent of the dollars for hard goods items."[45] The services had been preparing schedules for items that amounted to only 50 percent of the value of hard goods to be produced.[46] Second, to prevent accumulation of bloated inventories, the president said that he expected purchases of relatively easy-to-acquire soft goods to be kept in balance with acquisition of the more expensive and long-lead time items. Third, he wanted firm controls established for such special procurement categories as facilities, tools, lumber, petroleum, wool, and cotton goods. Finally, the department must have machinery in place for determining priorities among individual items or programs. This means, said the president, that "the Joint Chiefs have to be ready to give their advice on what is most essential, and the Munitions Board and the mobilization agencies have to know where and what the program is at all times."[47]

Only after this intervention by the commander-in-chief did OSD seek a firmer grip on the services' acquisition programs. During Marshall's temporary absence, Acting Secretary Lovett appointed a three-person committee to develop policies and procedures for carrying out the president's instructions. Small chaired the committee and was joined by General of the Army Omar N. Bradley, chairman of the Joint Chiefs of Staff, and Lyle S. Garlock, McNeil's deputy in the comptroller's office.[48]

It took time to hammer out the new policies and procedures. The services fiercely resisted a greater role for the Munitions Board chairman and staff in the development and execution of their procurement programs. Early in the process, William F. Schaub, a Bureau of the Budget official who worked closely with OSD and the services in preparing the annual military budget, told Director Lawton that "serious and basic differences" had arisen in the Defense Department over the extent of the Munitions Board chairman's authority to implement the president's guidance. According to Schaub, the military department members of the board did not want the chairman to have the power to determine production scheduling, to mandate inventory control systems, to coordinate procurement and production between the services and the mobilization control agencies, or to establish "general procurement and production policies."[49]

On 31 May 1951, a directive from Lovett revealed the outcome of the conflict over the authority of the Munitions Board chairman. It provided for a regular review of the services' hard and soft goods procurement programs to be conducted jointly by the OSD comptroller and the Munitions Board staff. On the surface, this appeared to be a victory for the Munitions Board. But in reality the services did not have to give up much power. According to Lovett's instructions, the Munitions Board chairman would determine the hard goods items for which schedules had to be submitted for review. Any disputes regarding the schedules that could not be resolved by the Munitions Board staff or the military department staffs would go to the board itself for decision. On the board, at this time, the chairman's vote prevailed only when the services disagreed.[50]

Despite their limitations, these procedures for reviewing the services' acquisition programs had several important consequences. First, although the initial production schedules prepared under the new system left much to be desired and problems as well as criticism continued, the mobilization control agencies eventually saw improvements in military requirements estimates. In his quarterly report to the president in January 1952, ODM Director Wilson noted that difficulties in coming up with "realistic" schedules had previously "hampered" the control of military production. But, he went on to say, "The underlying information needed for the preparation of firm production schedules . . . is now available. . . ."[51] Testifying at the end of 1952 before a House subcommittee holding hearings on federal supply management, Small asserted: "In solving the many problems of requirements we have made great strides."[52] Second, in addition to improving Defense Department requirements estimates and production schedules, in Small's view, the new control mechanisms had measurably increased the Munitions Board's role in acquisition. "Prior to the issue of the [Secretary's] directive," he told OSD's Management Committee, "the Munitions Board staff was not given the opportunity to take active part in the formulation of a Department of Defense production program and because of this it was not qualified to present the Department of Defense position effectively to the civilian [non-DoD] control agencies."[53] Lovett's directive had thus enabled the Munitions Board staff to achieve an objective it had long sought—a role in the development of the services' current procurement programs.

Although the Munitions Board's power and status had increased, its Achilles heel—domination by the services—remained. But, more important for the long term was that Lovett's directive represented OSD's encroachment on the services' acquisition prerogatives, and its erosion—albeit slight—of their power in this realm. The initiative, however, had come from the president rather than OSD.

PRODUCTION DIFFICULTIES

Measured by the value of hard goods delivered compared with funds appropriated, rearmament got off to a slow start. At the end of June 1951, approximately $30 billion had been available for hard goods procurement since the onset of the Korean War and, of this, 93 percent had been obligated under contract.[54] Yet only about $6 billion had been delivered.[55] A National Security

Council paper in August 1951 warned that although a "period of acute danger" lay directly ahead with the Soviet Union's acquiring as many as 200 atomic bombs by mid-1953, NSC 68's targets would not be met at the current pace and scale of effort.[56] By December 1951, a full year following approval of those objectives, an additional $29 billion had been appropriated for major procurement, but hard goods deliveries stood at only $12.5 billion.[57]

That production accelerated slowly was not surprising. Orders for military end items had been at a low level in the years between World War II and the start of the Korean War; it took time for industry to produce them again at high rates while continuing to meet the needs of the civilian economy. According to the Office of Defense Mobilization, 1951 was "a year of making ready" for full production—a year "of designing and engineering, of tooling up, of organizing and recruiting, of testing and modification, of starting materials through the production process."[58] Moreover, some weapons were so complex that the lead-time for producing them was measured in years.[59] The Senate's Preparedness Investigating Subcommittee, while aware of such considerations, was sharply critical of rearmament's slow pace. Hard goods deliveries, maintained the subcommittee in a November 1951 report, were "dangerously behind schedule" because the nation had failed "to make immediate defense hard goods production the top claimant upon our industrial capacity."[60]

Whether one accepted the relatively benign view offered by the Office of Defense Mobilization or the harsher judgment coming from Senator Johnson's subcommittee, many factors slowed production. As we have seen, unreliable requirements estimates and production schedules were high on the list. Other important causes were a lack of machine tools, shortages of raw materials, frequent design changes, and problems experienced by contractors in obtaining components for the end items they were producing.

Machine Tools

"Inability to obtain machine tools," stated a Munitions Board report of July 1951, "has probably been the largest single delaying factor in the military production program."[61] Six months later, the National Production Authority described the by-then two-year backlog in orders for machine tools as "the chief bottleneck in defense production."[62] Few would have disagreed with those assessments. Sometimes referred to as "machines that make machines," these cutting and grinding devices, that can shape metal parts to precise specifications, were crucial to modern weapons manufacture.[63] Referring to military aviation when rearmament began, Lovett told Johnson's subcommittee that "no one fully realized the extent to which high production manufacturing methods . . . had changed since World War II. Many special machine tools capable of holding almost unbelievably close tolerances had to be developed and produced."[64]

Delays in obtaining machine tools held up many a defense contract. In February 1952, for example, Air Force Maj. Gen. C. S. Irvine advised H. R. Boyer, deputy administrator of the Defense Production Administration, of problems encountered by the Burroughs Adding Machine Company in acquiring tools needed to manufacture a component of the J–2 aircraft compass. Although the tools had been ordered two months previously, Burroughs had heard nothing regarding their projected delivery. Without the compasses, stated the general, a minimum of 200 aircraft would be grounded by July.[65]

The machine tool industry had difficulty meeting rearmament demands for a number of reasons. So many machine tools were produced during World War II that there was little postwar market for new equipment, and the industry suffered a sharp decline, losing many of the highly skilled workers needed to design and build the precision machines. By mid-1950, many manufacturers lacked capital to expand. Others, even with money available, proved reluctant to do so. Remembering what had happened at the end of World War II, some feared that when the military crisis passed, contracts would be cancelled and they would be left with tools they could not sell. Others balked when the government imposed price ceilings in early 1951. To stimulate expansion, the government aided the industry through accelerated amortization of capital investment, pool orders (government-guaranteed purchase of new tools), and direct subsidies for special types of tools. Until these and other measures took effect, however, the supply of tools lagged well behind requirements.[66]

Raw Materials

As the pace of rearmament picked up in mid-1951, shortages of raw materials also began to affect production. Steel, aluminum, and copper, along with chromium, cobalt, columbium, molybdenum, nickel, and tungsten were all scarce.[67] Some of these materials were withdrawn from the government-maintained strategic stockpile in order to increase supply. In April 1951, the president approved a withdrawal of platinum, used in manufacturing the Navy's JATO (jet-assisted takeoff) units; in May, tungsten (for producing high-velocity armor-piercing shells); in August, copper; and in November, lead and aluminum.[68]

Mobilization planners sought to give priority to military contracts through the Defense Order rating system set up following passage of the Defense Production Act in September 1950. Defense Order ratings, however, were not a satisfactory system for establishing priorities among those contracts. Manufacturers and suppliers, including raw materials producers, simply filled orders in the sequence they were received. Although the mobilization control agencies issued a variety of orders intended to make certain materials available, tighter controls were needed. To distribute raw materials more efficiently, the Office of Defense Mobilization instituted the Controlled Materials Plan in July 1951. Superimposed over the Defense Order rating system and also operated by the National Production Authority, the Controlled Materials Plan allocated steel, along with aluminum, copper, and some other metals in short supply according to requirements estimates and production schedules provided by the services through the Munitions Board.[69]

Although certainly an improvement over the Defense Order rating system, the Controlled Materials Plan had its own weaknesses. For one thing, it was not set up to respond to the needs of a particular company for a specific program. When problems arose in individual cases, the Defense Department had to intervene to assist such firms. In January 1952, for example, the AMPCO Metals Company was forced to shut down due to a copper shortage.[70] On behalf of the Navy, Chairman Small requested special allocations of copper from the National Production Authority for the company. AMPCO used copper to manufacture aluminum bronze, a metal employed for its nonmagnetic qualities in the construction of Navy minesweepers with wooden hulls and nonmagnetic metal parts.[71] At that time, the minesweepers held the highest priority among all the Navy's shipbuilding programs.[72] So unglamorous a vessel had become critically important because in October 1950, during a mine-clearing operation near Wonsan harbor on North Korea's eastern coast, almost 100 Navy personnel were killed or injured and several vessels sunk, including two steel-hulled minesweepers. The Navy's lack of capability to sweep Soviet-supplied influence mines [those not requiring direct contact with the target for detonation] delayed the landing of 50,000 men in a 250-ship assault force for nearly a week.[73]

Design Changes

Along with machine tool and raw materials shortages, frequent changes by both the government and the contractor to end-item designs that had already been approved for production also caused output to lag.[74] Such changes, for example, were part of the reason that there were no deliveries of improved 60-mm. mortar ammunition for two years after the Korean War began.[75] Design modifications were also responsible for significantly reducing B–47 bomber and light and medium tank production below planned levels by the fall of 1951.[76]

The impact of design changes on production attracted the attention of mobilization control agency officials. The issue was discussed at a Defense Mobilization Board meeting in early September 1951. In October, ODM Director Wilson expressed his concern directly to Lovett: "Considerable emphasis should be given to a more practical approach to design changes, particularly with reference to aircraft and electronics production. Unless sufficient lead time is provided and unless changes except for those absolutely required to make the product operable are held to a minimum until proven, we will have serious production setbacks."[77] A few weeks later Clay P. Bedford, a special assistant to Wilson and chairman of the interdepartmental Production Executive Committee that coordinated the executive branch's response to production problems, reiterated the warning, telling the committee that design changes were "seriously retarding production output."[78]

Modifications to designs and other factors slowing production were often interrelated. Shortages of alloying metals, for example, forced jet engines to be redesigned, adding to production delays.[79] Design changes, in turn, exacerbated the machine tool problem because new tools had to be manufactured to accommodate the modifications. A National Production Authority report pointed out that "frequent changes in designs of military equipment and in reassessment of machine tool requirements have resulted in heavy placement of orders which later were cancelled and subsequently reordered. This has led to confusion and chaos in planning delivery by the industry and in lags in completing military production lines."[80] Another example from jet engine production illustrates the National Production Authority's generalization. Horace Turner, president of United Aircraft Corporation, told students and faculty at the Industrial College of the Armed Forces that 2,100 engineering changes had been made in the first through the nineteenth versions of the J57 turbojet engine as development proceeded concurrently with production. "These changes," he said, "cost us 410,000 dollars in tooling, which does not include the loss of tools that had already been made for the J57, and which must now be scrapped because of the engine's swift development."[81]

Components

When the director of procurement and engineering at Air Force headquarters spoke at the Industrial College of the Armed Forces in May 1950, someone in the audience asked him if planning was being done to prevent recurrence of the components bottleneck that had stymied production during World War II. Components, described by the questioner as "the Achilles heel of the production cycle," were the innumerable variety of parts, often combined into "subassemblies," that went into end items. Many, such as batteries, antifriction bearings, gears, hoses, small motors, and valves, were common to much military equipment; others, like the compass component mentioned previously, were highly specialized, even unique. The government furnished some components to its prime contractors; generally, however, the contractor either manufactured needed components or obtained them through subcontractors. "I can reassure you on that point," said the general. "We have recorded the experience in the last war. We do remember the airplanes that were stacked up on the fields, and we remember the why, and we have documented the why."[82]

The general's confidence notwithstanding, whatever planning for component production that had been accomplished by the Air Force or any other element of the Defense Department proved inadequate during the rearmament of 1950–1953. The Munitions Board, in its mid-1951 report on the status of materiel acquisition programs, listed inability to obtain components first among all the production problems experienced in the Navy's ship program.[83] During the first half of 1951, the services turned down 360 of 2,621 aircraft scheduled for delivery, mostly for lack of components.[84] At the end of the year, 22 of 96 major end-item programs had experienced delays in receiving components.[85]

Problems with components persisted throughout the buildup and were especially hard to solve.[86] For one thing, timing component production and delivery to coincide with scheduled end-item completion was a difficult task.[87] Furthermore, little historical data was available for estimating component demand and production capacity. "Comprehensive information," Charles E. Wilson, Eisenhower's first secretary of defense, was told early in 1953, "has not been available at government or prime contractor levels because many critical components are incorporated in sub-assemblies far down the subcontracting chain, on performance specifications, rather than on size, type or quality specifications."[88] Inaccurate estimates of component requirements meant faulty allocations of raw materials. Manly Fleischmann, who had headed both the Defense Production Administration and the National Production Authority, asserted, in fact, that "the main trouble with operating a controlled materials plan . . . has been the whole problem of components and sub-assemblies."[89]

Getting better control of component production was also important because it was particularly susceptible to "apex" or "inverted pyramid" buying. In this procurement practice, many contractors might depend on a subassembly manufactured by a small number of producers that in turn relied on a single company for one component of that subassembly, potentially leaving entire production programs vulnerable to relatively easy disruption. In addition to its potential to create bottlenecks, "apex" buying was contrary to the administration's policy of using procurement to broaden the industrial base.[90] But the services—through the instrument of negotiated sole-source contracts—preferred relying on prime contractors with proven performance records. Similarly, prime contractors also tended to turn to subcontractors and suppliers best able to provide components that met specifications at an acceptable price.

Machine tools, raw materials, design changes, and components were not, of course, the only threats to production. Strikes took their toll. The steel shutdown that began on 2 June 1952 and lasted until 24 July had the greatest impact, halting production in more than 380 steel plants.[91] Within a month, military production had been affected in 214 of those plants.[92] The strike bore heavily on ammunition output. The Munitions Board estimated production of six of eight of the highest priority types of ammunition could not be made up until June 1953.[93] Aside from shutting down nonessential production lines to husband steel inventories, the Defense Department could do little on its own about strikes.[94] But it could take steps to overcome the other major obstacles to production.

THE ATTACK ON PRODUCTION DELAYS

The Department of Defense was under heavy pressure to better manage its materiel programs in the late fall and early winter of 1951. Members of a House subcommittee, then on an inspection tour of U.S. military facilities in Europe as part of an investigation of the management of federal supply activities, were reportedly unhappy about apparent duplication in Army and Air Force supply operations.[95] Most attention, however, focused on production delays. ODM Director Wilson, at a Defense Mobilization Board meeting on 28 November 1951, said that he did not think bottlenecks would be easily overcome and that "more drastic steps" might have to be taken. But, he argued, "we should identify our bottlenecks and aim with a rifle, not shoot with a shotgun at the entire program, as some of our critics have tended to do." Deputy Secretary of Defense William C. Foster agreed, declaring that "shortages and bottlenecks in the existing program must be spotlighted and accorded full emergency treatment."[96]

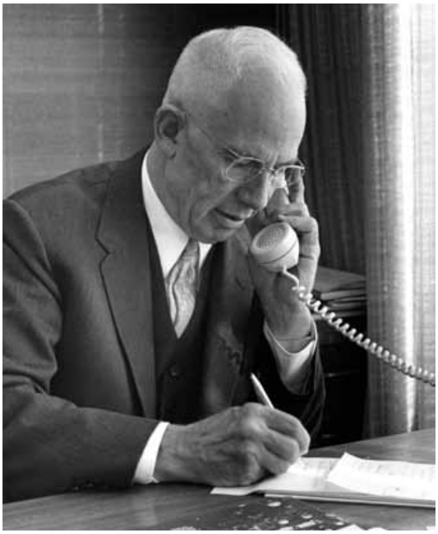
At about the same time, as we have seen, Lyndon Johnson's subcommittee, unhappy with the pace of mobilization and preferring an all-out effort, instead of the partial one being conducted by the administration, was charging that the Defense Department lacked "independent over-all coordinated supervision and direction of procurement." In its *Interim Report on Defense Mobilization*, the subcommittee recommended that the department designate a "procurement czar"—either a new under secretary responsible only for procurement or a Munitions Board chairman with enhanced powers—who would be able to "oversee and expedite procurement for all the Armed Services and to resolve all conflicts among them." It also called for bottlenecks to be pinpointed and eliminated, and for the services to be required to share their machine tool reserves.[97]

That the subcommittee felt compelled to urge the military departments to pool their machine tool resources was both a reflection of how little "unification" had actually taken place since 1947 and also a clear indication that OSD's acquisition structure had failed to measure up to the demands of stepped-up production. In June 1950, the government had a known, mostly warehoused, reserve of 130,131 machine tools left over from World War II; most were controlled by the three military services.[98] A year later the Office of Defense Mobilization directed that tools be made available from the government reserves. The Munitions Board established a central inventory for this purpose, with data on each tool recorded on an IBM [International Business Machines] card that could be reviewed by military department contractors.[99] The Air Force suspected the Navy was using the card-screening procedure as a way to hoard tools. In the Air Force's view, the Navy, by insisting that evaluation of tools be made from review of the cards rather than from an on-site inspection, was making it nearly impossible for contractors to determine whether a tool, with some modification, could be put to use. H. K. Clark, deputy for production in the Office of the Under Secretary of the Air Force, expressed these concerns in a formal memorandum to Lovett at the end of October 1951.[100] In a personal ("Dear Bob") letter accompanying the memorandum, Clark wrote: "The idea of having tools examined and selected from IBM cards is fantastic. It makes a lot of paper, provides cause for a lot of meetings, and only spits out Navy machine tools with about the same regularity as the three plums come up on the one-armed bandits in the officers' club."[101] Lovett directed the services to make idle tools available to each other or to industry; the Navy declared its willingness to cooperate, but Clark was not satisfied with the results. A month later, he complained again to the secretary of defense that the Navy was still not permitting contractors to visit its tool storage locations.[102]

The Air Force's conflict with the Navy over machine tool reserves was precisely the kind of problem the Munitions Board could not resolve as long as the chairman's power was limited. Early in December 1951, Lovett, now secretary of defense, asked William D. Pawley, one of his special assistants, to look into the machine tool imbroglio.[103] In his report, submitted at the end of the year, Pawley agreed that physical inspection of tools was vital, but also found both services less than forthcoming in listing idle tools in the central inventory.[104] Based on the report's recommendations, Deputy Secretary of Defense Foster then directed the Munitions Board to prepare appropriate directives for his signature that would ensure maximum use of government-owned machine tools.[105]

In the meantime, with the Johnson subcommittee's suggestion for a "procurement czar" hanging in the air, Lovett moved to shake up the Defense Department's rearmament structure and process. On 18 December 1951, he named Clay Bedford, then Wilson's special assistant at the Office of Defense Mobilization and chairman of the Production Executive Committee, to head a production expediting effort in OSD.[106] Securing Bedford's services was a skillful move on Lovett's part. It appeared to respond to the Preparedness Investigating Subcommittee's call for a "procurement czar." It also made a high-level official from one of the mobilization control agencies, organizations often critical of military procurement practices, part of the Defense Department team. But mostly it promised that the department might be able to do something about production bottlenecks.

Although reporting directly to the secretary of defense, Bedford was not put in charge of all military procurement. His mandate from Lovett was limited—"to expedite military production items of critical urgency on which delays are being encountered."[107] Moving quickly, Bedford established an "Office of Special Expediting" with a small staff that included representatives from the Munitions Board and the services. Next, collaborating with the military departments, he identified 5 to 10 of each service's high-priority programs that needed attention. He then secured the agreement of the JCS, the Munitions Board, and the services to special procedures for handling problems involving critical materials, components, machine tools, or other production equipment associated with those high-priority programs. A department directive, issued on 21 February 1952, codified the procedures to be followed and listed the programs or items to be expedited.[108] The new arrangements eliminated some of the hurdles in the Defense Department bureaucracy that a manufacturer experiencing a specific production difficulty had to overcome before the National Production Authority could address the problem, especially the requirement to go first through the service's headquarters and the Munitions Board.[109]


Clay P. Bedford
Courtesy, Institute Archives and Special Collections, Rensselaer Polytechnic Institute, Troy, N.Y.

Clay P. Bedford (1903–1991)

When Secretary of Defense Lovett brought him to the Defense Department to expedite production in December 1951, Clay Bedford possessed a reputation as an extraordinarily talented industrial manager and efficiency expert. Born in Benjamin, Texas, in 1903, Bedford graduated with a degree in civil engineering from Rensselaer Polytechnic Institute in 1924. The next year he went to work for the Kaiser Paving Company and rose rapidly in industrialist Henry J. Kaiser's business empire, making his mark as the manager of several large-scale construction projects. Before World War II, Bedford was the chief engineer for the construction of the Central Highway in Cuba, transportation superintendent during the construction of Hoover Dam (a.k.a. Boulder Dam), and general manager for the construction of both Grand Coulee and Bonneville dams. He belonged to a group of a half-dozen or so men in their thirties (including Kaiser's son, Edgar) that *Fortune* magazine said "keep the promises that Henry makes."

During World War II, he was the vice president and general manager of the shipyard operations at Richmond, California. He gained notoriety in 1942 by reportedly supervising the construction of a 10,500 ton "Liberty" cargo ship in four days, fifteen and a half hours. In part, Bedford was able to achieve the Richmond shipyard level of wartime productivity—727 vessels in five years—by applying to ship construction the assembly line methods he had observed at Ford automobile factories in which workers specialized in specific tasks: "So we attempted to set up a specialization program on the same basis, so that when making any certain section . . . or welding in the pipes or doing any one of the single simple chores that are to be done on a ship, then that job was done by the same crew every day."

After World War II and before coming to the Office of Defense Mobilization and then to the Pentagon during the Korean War, Bedford was executive vice president of the Kaiser-Frazer Corporation, manufacturing automobiles at Willow Run, Michigan. Following his government service, Bedford returned to Kaiser Industries. He retired in 1976 as president of Kaiser Aerospace and Electronics and died in 1991.[II]

The procedures for expediting production developed by Bedford's office received considerable praise. Fleischmann, then the DPA administrator, asserted that "The work that has been done in the Defense Department by Mr. Bedford and his staff, working with the Munitions Board, to me, if not miraculous, is sensationally successful."[110] The president of the Aircraft Industries Association of America wrote Bedford that the expediting procedures had "very considerably reduced the processing and resolution time for critical shortage cases that have ultimately to be sent to NPA for directive action."[111] The deputy Air Force member of the joint-service Aircraft Production Resources Agency (the Korean War successor to the Aircraft Scheduling Unit described in the preceding chapter) claimed that processing time had been cut in half on special assistance cases.[112]

Not everyone was so enthusiastic. In April 1952, the Munitions Board staff incorporated the procedures into its priorities and allocation manual (routinization being the ultimate compliment in a bureaucracy) and the directive establishing them was cancelled.[113] Later, the Permanent Logistics Reviewing Committee of the Joint Chiefs of Staff, perhaps because the services' headquarters had been cut out of the approval process for cases to be expedited, wanted the special procedures removed from the manual.[114] By then, however, the point was moot. Bottlenecks had been broken and the need for special expediting procedures diminished. Moreover, the Truman administration's decision to stretch-out the weapons buildup had also eased the production crisis.

Bedford's Office of Special Expediting carried out activities that should have been performed by the Munitions Board. In fact, the very existence of Bedford's operation demonstrated that the board had failed to meet the challenges presented by war and rearmament. Called to testify in July 1952 before the House subcommittee holding hearings on federal supply management, Bedford, who had left OSD in May (he had planned to stay only four months), was pressed hard on the board's effectiveness. The subcommittee chairman, Congressman Herbert C. Bonner (D-N.C.), was blunt: "If the Munitions Board had functioned as intended, would an expediter be necessary?" Bedford, tactful and indirect, replied: "The area [of procurement] is so great that there is always going to be room for improvement, so that although the Munitions Board had more staff of a management type and could have improved their relative performance, I still feel that needling is not only a helpful function but a necessary function. An expediter is a needler. He keeps putting the people back on the track."[115]

At the end of the hearing, Bonner asked Bedford to submit a written statement further commenting on the board's performance. In that document, Bedford was more direct. The board, he said, was especially weak in resolving "controversies which arise among the services in the operation of our military production work." In his view, this was true because the board, as constituted, "cannot judge impartially in the interests of the Nation. Rather it becomes necessary for each service member to advocate the particular interests of his service. This is no discredit to the men concerned. They are able and conscientious, but you cannot be both judge and advocate simultaneously. The result is that the Board essentially is a debating society among the three services. . . ."[116]

While at the Office of Defense Mobilization, Bedford had been among those critical of frequent design changes made to end items already in production because the changes raised costs and slowed output. Pressure to "freeze" or otherwise limit such changes posed a dilemma for the military, requiring that choices be made between achieving volume production (quantity) and acquiring the most capable systems (quality). The military, especially the Air Force, almost always preferred the latter. Superior performance became an article of faith in the services and resonated with increasing force in the post–World War II decades as the United States came to depend more and more on advanced technology to provide the margin of superiority over the Soviet Union.[117]

In the years preceding the Korean War, both the Research and Development Board and the Munitions Board had urged the military departments to take "producibility" [ease of manufacturing] into account as they developed new weapons. Wherever possible, said the boards, the services should avoid planning to use scarce materials, and should also incorporate easily obtainable, standard commercial ("off-the-shelf") products into their designs.[118] These, however, were recommendations, not directives, and the services were inclined to ignore them.

After rearmament began, OSD only slowly, and only temporarily, came to grips with the production problems caused by numerous design changes. In April 1951, probably as a result of criticism by OSD staff during a review of its production program, the Air Force halted changes to aircraft on production lines, with some important exceptions (see chap. 5).[119] In mid-May, the Munitions Board requested, but did not direct, the Army and Navy to consider imposing similar restrictions in their own programs.[120] (The Navy did not even bother to reply to the memorandum.)[121] Six months later, following reports to the president by ODM Director Wilson highlighting design changes as a factor slowing production, Small asked the services to again "consider this problem" and to determine the extent to which design changes could "be eliminated or temporarily suspended so as to attain the scheduled production goals."[122] At about the same time the Navy, in submitting its FY 1953 budget estimates to the secretary of defense, reported that it had found it necessary to "freeze" designs in FY 1951 and FY 1952 "in order to obtain military end items to equip the expanded forces."[123]

Up to this point, all of the service actions limiting design changes had been self-initiated. By the end of 1951, however, OSD had become more assertive in this area. At a meeting of the Production Executive Committee in December, a Department of Defense representative reported that the military services had been issued directives requiring design changes "be kept at a minimum and those actually made be integrated in the production pattern in such fashion as to minimize reduction of output."[124]

Despite the imposition of restrictions, whether initiated by the services or mandated by OSD, design changes continued to be made and, whether justified or not, continued to draw the fire of critics.[125] Publicly, Lovett and other Defense Department officials supported the need to make changes, including those improving quality.[126] Privately, or in controlled environments, they were more skeptical. In a speech at the Industrial College of the Armed Forces, Small remarked wryly that "A gleam in somebody's eye last night has to be in the production line today."[127] In October 1952, during a meeting to review the Army's proposed FY 1954 budget, Lovett expressed doubt whether so many performance-enhancing improvements were necessary. At the meeting, he told the Army's top civilian and uniformed leadership that the services "may run head on into difficulties, unless all cease the practice of buying more and more gadgets to hang on our aircraft, tanks, even jeeps, and other military equipment."[128] Both Lovett and Small likely would have agreed with the philosophical approach to development expressed by Robert Watson-Watt, who led the team that demonstrated the feasibility of radar in Great Britain during the 1930s: "Give them the third best to go on with; the second best comes too late, the best never comes."[129]

Everyone agreed that some design changes would have to be made. The rub lay in determining which changes to make, and who should decide. Testifying in secret session before Senator Johnson's subcommittee in May 1952, General Bradley conceded that at some point production models must be frozen. Johnson asked whether there was anyone in the Defense Department who could say "stop this tinkering." Bradley said that under the present defense structure the services, the users of the equipment, determined when production should begin. But, in his opinion, "we ought to have somebody in authority in the Department of Defense that could do that."[130] Bradley's suggestion was not implemented, and the problem of design changes would plague the department for decades to come.

In addition to establishing the Office of Special Expediting and initiating half-hearted measures to control design changes, OSD pursued other means to speed production and achieve the administration's mobilization goals. These actions included chartering the Aircraft Production Resources Agency, encouraging the services to contract more with small business, and taking advantage of an offshore procurement program. Often, service independence and the lack of clear lines of responsibility and accountability hampered these efforts.

The principal responsibility of the joint-service Aircraft Production Resources Agency, chartered in early 1951 and under the policy guidance of the Munitions Board, was to assist aircraft manufacturers in obtaining raw materials and components. By the spring of 1952, the organization had handled more than 4,500 of approximately 5,000 requests for help in alleviating raw materials shortages, and more than 90 percent of the 3,200 requests related to components without having had to refer them to the mobilization control agencies.[131] However, as the Aircraft Production Resources Agency grew in size and expanded its activities into requirements computation (traditionally a service responsibility), the Air Force viewed it as overstepping its charter and becoming an independent operating organization. In response to Air Force concerns, Small restricted the agency to performing only those duties specified in its charter (requirements computation not being among them). Nevertheless, the services and the Munitions Board could never agree on the extent to which each could exercise jurisdiction over the Aircraft Production Resources Agency or the scope of the agency's responsibilities.[132]

Claiming it to be a matter of equity and also a way to broaden the nation's production base, Congress and Truman administration officials repeatedly encouraged the Defense Department to contract more extensively with small businesses (defined then as those having fewer than 500 employees).[133] In December 1950, when the decision was made to accelerate procurement, Secretary of Defense Marshall called upon the military departments to support these policies, making the "fullest possible use" of such companies.[134] Vice Adm. Edwin D. Foster, chief of naval material, warned that if the services did not do so, Congress would require them to and the military would lose control of contract awards.[135]

OSD took several steps to increase small business participation in the rearmament program. The Munitions Board promoted the appointment and training of "small business specialists" in the military departments, set up procurement information centers and displays of typical military supply items, held small business clinics, and sponsored joint contractor-subcontractor parts exhibits. The board also encouraged small businesses to join together in "production pools" to better compete for contracts. Additionally, the Defense Department denied funds to prime contractors for plant expansion if it appeared that work under the contract could be subcontracted, and in late 1952, restricted certain advertised procurements to bids from small businesses only.[136]

Regardless of protests that small business was not receiving its "fair share" of government contracts, the reality was that such firms did fairly well. The Defense Department contracted for about $100 billion in supplies, services, and construction from American businesses from July 1950 through June 1953. Small companies received just over $18 billion of the dollar value of the $100 billion in prime contracts. This did not include the value of subcontracts small firms might have received from big prime contractors. Since OSD considered only 30 percent of the total value of contract awards suitable for small businesses—they obviously could not mass-produce a tank or build an aircraft carrier—the actual percentage taken by such enterprises was quite respectable.[137]

When it came to broadening the industrial base, more contract awards to small businesses could have had only a limited effect. Stimulating the growth of industrial enterprises able to produce complex, high-cost end items in large volume would probably have much greater impact. But the services were reluctant to award contracts to companies that might require time or additional resources to gear up for production, preferring to do business with firms that were well established and had a record of proven performance. For example, during review of the Army's 1954 budget proposal, Maj. Gen. William O. Reeder, deputy assistant chief of staff for logistics, when asked to consider producers for its medium tank other than those already selected, replied that "the Army reserved the right to select its own contractors."[138] Thus, throughout this period, hard goods production continued to be dominated by a small number of firms. Of the $80 billion in value of contracts awarded between July 1950 and December 1952, the top 100 companies and corporate groups pulled in $50 billion worth. The first 10 garnered almost 30 percent of the $80 billion total.[139]

Along with steps taken domestically to increase hard goods production and expand the mobilization base, OSD looked overseas. Its offshore procurement program was intended to help achieve both objectives. Formally inaugurated early in 1952 with the Army as executive agent for the Defense Department, offshore procurement involved placing contracts with European firms to produce military equipment for allied forces to fulfill U.S. commitments under the administration's multibillion dollar Mutual Defense Assistance Program. By mid-1953, $2.2 billion had been obligated to support offshore procurement. In addition to expanding production capabilities in NATO countries, the program also promised to strengthen allied forces more rapidly and at less cost than if materiel came from American producers, and to bolster European economies generally.[140] But in the summer of 1951, when Lovett directed the services to begin planning for offshore procurement, OSD officials mostly hoped it would ease the burden on U.S. plants then behind schedule in manufacturing hard goods for both American forces and for military assistance.[141]

The services disliked offshore procurement, protested to Lovett about it, and dragged their feet executing it. For one thing, differences in contracting practices between the United States and European countries made administering the program a nightmare. For another, the services argued that the program diverted funds that could otherwise be used to keep production lines running in domestic plants. The services also saw offshore procurement as being used to support primarily political purposes as opposed to the main objective—the U.S. military buildup. In this latter instance, Lovett and Deputy Secretary of Defense Foster sided with the services against administration officials directing the military assistance program who wanted to expand offshore procurement.[142]

During the Korean War rearmament, OSD sought to alleviate production problems in a variety of ways and achieved a measure of success. It took steps to break the logjam hindering distribution of machine tools from the services' stockpiles, temporarily slowed the frequency of design changes, instituted measures to expand small business participation in defense production, and exploited European manufacturing capabilities. More often than not, however, OSD's posture was reactive, and its responses often slow. Appeal rather than coercion was its preferred means of eliciting cooperation from the services. Although the Office of Special Expediting broke production bottlenecks, its creation was testimony to inherent weaknesses in OSD's acquisition management structure. Another indication of these defects was the internal struggle within OSD during the winter of 1951–1952 to set production priorities.

PRODUCTION PRIORITIES

In April 1951, when he spoke in the White House to the key officials in his administration directing the rearmament program, President Truman emphasized that the Department of Defense must set priorities. "It is a problem," he said, "of getting our resources behind the most important items and programs." To do this, the Joint Chiefs of Staff "have to be ready to give their advice on what is most essential. . . ."[143] The JCS failed the president in this regard. In the fall of 1951, as resources grew tighter and output lagged, the Joint Chiefs dragged their feet when pressed for priorities, taking almost five months to specify the military's top production programs in order of importance. Bedford, who was instrumental in ending the impasse, told Congressman Bonner's subcommittee in the hearings on federal supply management that the JCS had difficulty acting for the same reason the Munitions Board was often paralyzed. "Since each Chief of Staff," he said, "is advocate for his service as well as judge of the common interest, speed in obtaining relative military urgencies has been rather slow."[144]

In line with the president's guidance, the mobilization control agencies began asking the Department of Defense for production priorities early in the summer of 1951.[145] In response to the increasing pressure, and based on "broad strategic guidance" from the Joint Chiefs of Staff, the Munitions Board drew up a plan for establishing "relative military urgencies." Published in September 1951, the plan divided hard goods items into four categories. Category "S" (Special), the highest priority, was reserved for programs to be selected by the Joint Chiefs of Staff. (The Joint Chiefs did not identify any programs for the category until December.) Three numbered categories, with items identified by the services, followed in descending order of importance. Category 1 included materiel for ongoing combat operations, U.S. forces overseas, first-tier aircraft and ship programs, and some research and development projects. Category 2 was for initial unit equipment, peacetime requirements, and second-tier aircraft and ship programs. Reserve stocks were assigned to Category 3.[146]

It soon became apparent, however, that the priority system had a fundamental flaw. Most production fell into the top two categories ("S" and "1"); all of it could not be accommodated according to schedule when resources, particularly machine tools and some raw materials, were limited.[147] At the end of October 1951, Small wrote Lovett that, in some cases, military demands for resources were exceeding the available supply. The solution, he suggested, was for the Joint Chiefs of Staff to give more precise guidance regarding production priorities. Small complained that the Munitions Board staff, in the context of mobilization planning, had been after the JCS for such instruction since early 1949 but had received little in the way of useful advice. The JCS position, he explained to Lovett, was that all tasks specified in the approved war plan were equally important and had to be supported; if shortages occurred, the Joint Chiefs planned to address them after M-Day (the day war began). "It is believed," Small concluded sardonically, "that the situation envisioned by the Joint Chiefs of Staff as occurring with M-Day has been reached."[148]

Lovett decided to act. On 8 November 1951 he sent identical memoranda to the Joint Chiefs of Staff and to the Munitions Board chairman (to the latter probably for form's sake), incorporating much of the language of Small's memorandum. He suggested that if the JCS and the Munitions Board worked closely together, production shortages might be alleviated. "An initial step in this direction," he told the chiefs, "might be the establishment of a relative priority list of our military missions."[149]

Asking the Joint Chiefs of Staff for a priority listing of military missions was akin to throwing fuel on hot embers—bound to produce an intense fire if not an explosion. Certainly Lovett knew this. Then why did he do it? One motive may have been pressure from the mobilization control agencies. ODM Director Wilson had written Lovett on 23 October 1951 about the need "to be more specific" when it came to production priorities.[150] Another, more compelling reason may have had to do with reducing the large gap between the amount of money the services said they needed to pay for force levels approved for FY 1953 and the budget OSD was planning to propose to the president to fund the programs. On 11 October, the JCS reported the services would require $64.2 billion. The Office of Defense Mobilization, however, indicated to OSD comptroller McNeil that so high a level of expenditures would have a negative impact on the economy. Lovett then decided to propose a $45 billion planning figure for the FY 1953 Defense Department budget. Although both Lovett and the president realized that more money might be required, Truman nevertheless approved the $45 billion figure for planning.[151] Lovett may have hoped a priority listing of missions furnished by the JCS would constitute an agreed basis on which to make decisions about cutting or deferring (stretching out) military programs.

Joint Chiefs of Staff, 1952 (left to right): General J. Lawton Collins, General Hoyt S. Vandenberg, General of the Army Omar N. Bradley (chairman), and Admiral William M. Fechteler.

When it reached the Joint Chiefs of Staff, Lovett's memorandum had a predictable effect. The services split over determining mission priorities that, in turn, governed production priorities for particular weapon systems. The Air Force—the only service able to deliver nuclear weapons at long range and, since no surface-to-air missile was yet operational, also with the most air-defense capability—pushed the JCS to specify priorities, presented an ordering that favored its forces, and insisted that production reflect that hierarchy.[152] Supported by the Joint Staff, the Army and Navy—less able at that time to project power against the Soviet Union or defend against Soviet air attack—opposed setting mission priorities. The older services argued instead that every task enumerated in joint war plans was essential for preserving national security. Production should be geared to developing "balanced" forces able to carry out all the tasks.[153]

While the JCS debated, other top Defense Department officials grew impatient. On 27 November the Armed Forces Policy Council, chaired by the secretary of defense, concluded that the production priority situation was becoming critical; a solution had to be found quickly. The council directed the Joint Chiefs to reply to Lovett's 8 November memorandum "as a matter of high priority."[154]

Another week passed; still no answer from the JCS. On 4 December a letter from ODM director Wilson to Lovett captured everyone's attention. Wilson reiterated the need for the Defense Department to determine the relative importance of its programs. He pointed out that to meet requirements for the Air Force's J47 engine (used in the F–86 fighter and B–47 and B–36 bombers), machine tools would have to be diverted from the other services' programs. Wilson told Lovett that, on his own authority, he had directed Office of Defense Mobilization agencies to make resources available to accomplish J47 production. Until the military establishment supplied a priority list, he warned, "I propose to select for intensive action, programs which appear vital to achieving the aims of the common effort."[155]

Faced with the prospect that the Office of Defense Mobilization would determine what should be produced, Defense Department officials moved quickly. On the same day Wilson's letter was dated, the three under secretaries of the military departments and the acting chairman of the Munitions Board (Robert M. Hatfield, Jr., in Small's temporary absence) met with the Joint Chiefs to decide how to respond.[156] The attendees agreed that each service would prepare two lists of its own programs. The first would be six end items to be assigned to Category S, the top category in the Defense Department urgency system. The second would be a listing for Category 1 of those programs of lesser importance but still sufficiently urgent to require preferred treatment. Each listing would be a priority ordering. The Munitions Board would then integrate the lists into a single Department of Defense urgency list and submit that to the Joint Chiefs of Staff for approval.[157]

The military departments and the Munitions Board completed their work in two weeks, and Acting Secretary of Defense Foster forwarded the proposed "Department of Defense Master Urgency List" to the JCS on 22 December 1951. Although the military departments had agreed initially to establish a priority order for the items to be included in Category S and the Munitions Board staff had recommended one, the board decided against a priority listing. All Category S items would have equal importance. In contrast, items in Category 1 were listed numerically in order of relative priority. Category 1, however, was not a true priority ordering but rather a mechanical integration of each service's list. The first end item in the Category 1 list was the top Air Force program; number two was the Army's first choice; and number three, the Navy's. This sequential pattern (Air Force, Army, and Navy) repeated itself down through the 200 plus items in Category 1.[158]

Despite the threat from the Office of Defense Mobilization, the JCS continued to be reluctant to specify priorities. Finally, on 11 January 1952, after consulting with the services and making some adjustments in the two categories, the Joint Chiefs approved both the Category S and Category 1 lists for dispatch to the Office of Defense Mobilization. The JCS did not, however, alter the character of either list. All items in Category S enjoyed the same priority and Category

1 continued to be a mechanical integration of each service's priority list.[159] For the moment, the Air Force had backed away from its demand that production priorities be related to mission priorities but made it a matter of record that it considered the lists only an interim solution.[160]

By mid-January 1952, the Department of Defense had identified its most important production programs to the Office of Defense Mobilization. But the Master Urgency List did not solve the resource allocation problem. Even the relatively small number of end items in Category S would require more resources than could be supplied at the same time. The mobilization control agencies still needed a priority ordering of these end items.

Both the Munitions Board staff and Clay Bedford, the department's special production expediter, began to press for a priority listing. At the end of February, in a status report on the operation of the department's urgency system, the Munitions Board staff pointed out that manufacture of Category S items would require more machine tools and other production equipment than would be available in the coming year. Choices would have to be made. "The solution of conflicts is complicated," stated their report, "in that all items in the "S" category have equal precedence." But despite the "absence of guidance" regarding the relative urgency of items in that category, said the staff with a jab at the JCS, the board was doing its best to resolve conflicts as they arose.[161] Lovett forwarded the report to the Joint Chiefs for comment and recommendations.[162]

Bedford, much more aggressive, persuaded Deputy Secretary of Defense Foster to arrange for him to brief the JCS on his suggestions regarding the urgency system. Bedford attended the Joint Chiefs' meeting on 7 March and presented his ideas.[163] No record of what he said has come to light thus far, but it is almost certain that Bedford urged the JCS to list Category S items in priority order. Three days later, he submitted a formal memorandum to the secretary of defense recommending that the Joint Chiefs of Staff be requested to combine the Category S and Category 1 lists, putting items from both in one numerical arrangement from most to least important.[164] Lovett asked the JCS to consider Bedford's memorandum "as a matter of priority."[165]

Stalled over the issue of relating production to mission priorities, the JCS did not reply for two weeks. Finally, on 25 March 1952, without having resolved their dispute but unable to delay any longer, the Joint Chiefs numbered Category S end items in priority order. They did not specify the criteria they used, but examination of the revised list suggests that the principal determining factor was an item's relative importance to the fighting in Korea. In any case, a footnote to the list showed that the JCS were not willing to cede control over resource allocation to the mobilization control agencies. "In affixing relative priority numbers to the items so listed," they stated, "it should be clearly understood that the J. C. S. are not agreeing to having any one item on this list helped at the expense of any other item on the list unless all other alternative sources of help have been exhausted.

In the event such a case develops, the J. C. S. should be advised of the situation as a matter of urgency."[166]

The Office of Defense Mobilization had its production priority list. But much time had passed—almost a year since the president had told Defense officials, particularly the JCS, to determine priorities; nine months since ODM first asked for such a listing; and almost five months since the secretary of defense requested one from the Joint Chiefs. The president and the policy of partial mobilization had not been well served. The lack of responsiveness may be attributed to several causes. The Munitions Board recognized the need for priorities but lacked the power to force them from the JCS. The secretary of defense had the power but did not lean very hard on the Joint Chiefs. For their part, the JCS, rather than promptly compromising differences for the sake of the larger national purpose, succumbed to prolonged interservice bickering.

RESEARCH AND DEVELOPMENT

This chapter has focused thus far on procurement, especially difficulties associated with production. Because of concerns expressed by the president, Congress, and the mobilization control agencies regarding the economic impact of spending such large sums so rapidly and the inability to meet initial production schedules, this aspect of acquisition naturally drew much of OSD's attention. Research and development, however, proceeded apace, producing some remarkable advances in weaponry. In seeking to carry out its research and development responsibilities, OSD found, as with procurement, that its organizational structure was fragmented and ineffective. To solve the problems, OSD pursued alternatives outside the established management framework.

In the fiscal years 1951–1953, Congress appropriated $4.34 billion for the military departments' research and development programs, about 2.8 percent of total Defense Department appropriations during those years and a significant increase in absolute terms over the $2.26 billion appropriated for FYs 1947–1950.[167] This expansion in R&D funding required the engagement of many more scientists and engineers; two-thirds of the nation's total supply, according to one estimate.[168]

The military departments applied some of their research and development resources to the war in Korea. For example, in less than eleven months, the Army designed, developed, tested, and made available to its frontline troops a rifle-fired grenade that illuminated the battlefield.[169] Air Force engineers devised solutions to a number of operational problems encountered by its F–80, F–84, F–86, and F–94 jets in Korea, particularly modifications to the F–86 to improve its performance against the Soviet MiG–15.[170]

During the Korean War, however, most research and development resources were directed at weapons for the future to be used to deter or fight the Soviet Union. Although none were deployed to Korea, the Army developed and produced several new tanks—the M41 (light), M47 and M48 (medium), and M103 (heavy).[171] When the Air Force's B–52 long-range jet bomber, designed to deliver nuclear weapons in the strategic air offensive, first flew on 15 April 1952, the Joint Chiefs of Staff immediately placed it on the "S" urgency production list.[172] A year later, a nuclear-powered submarine became the Navy's highest priority shipbuilding program, replacing minesweepers in the JCS "S" urgency category and facilitating the January 1954 launch of *Nautilus*.[173] Each of the services were pursuing aggressive guided missile programs—a total of more than 40 different systems by 1953.[174] Several missiles went into production, but none would be operational by the end of the Korean War. On 1 November 1952, on a small South Pacific island, came the most dramatic demonstration of U.S. prowess in developing advanced weapons technologies—detonation of the world's first thermonuclear device, a hydrogen bomb called the "super." Its 10.4 megaton yield was 1,000 times greater than that of the atomic bomb dropped over Hiroshima and more than twice that of all the TNT exploded during World War II.[175]

Since 1947 every secretary of defense had kept close watch over atomic energy matters, according them special status in OSD. As a member of the National Security Council and of the three-member Special Committee on Atomic Energy, the secretary played a key role in formulating policy for nuclear weapons. But by law, responsibility for the development and production of those weapons lay with the civilian Atomic Energy Commission. The Department of Defense became involved in the nuclear weapons acquisition process primarily at its front and back ends. The Joint Chiefs of Staff determined how many bombs were required; the services supported the test program, helped maintain the devices (in the custody of the Atomic Energy Commission) after they had been manufactured, and developed the means to deliver them. The Defense Department made its views known on the whole range of Atomic Energy Commission activities related to nuclear weapons through the Military Liaison Committee. Chaired by a civilian appointed by the president, the committee was part of OSD. In addition to the chairman, who also functioned as a special assistant on the secretary's staff, its other members included two flag officers from each of the services who also sat on the Research and Development Board's Atomic Energy Committee.[176]

Other than policy with respect to atomic energy, the primary responsibility for coordinating the military establishment's research and development programs belonged to the Research and Development Board. The board's membership changed late in 1949; a civilian under or assistant secretary from the military departments replaced one of the two uniformed officers from each service who had sat on the board until that time.[177] Also that fall, Karl Compton resigned as the board's chairman. He was succeeded in March 1950 by William Webster, a Naval Academy graduate, vice president of the New England Electric System, and former Military Liaison Committee chairman.[178] Webster steered the board's committees away from the time consuming, detailed scrutiny of every research and development project submitted for review by the military departments toward a focus on areas each committee thought to be "of greatest consequence."[179] Webster returned to private life in July 1951 and was replaced by Walter G. Whitman, head of the chemical engineering department at the Massachusetts Institute of Technology since 1934, and a member of the Research and Development Board's Committee on Fuels and Lubricants and the Atomic Energy Commission's General Advisory Committee.[180]

In February 1950, to provide the Research and Development Board with some means to shape the services' programs, Secretary of Defense Johnson held back $25 million from the total funding for research and development allocated to the services for planning the FY 1952 budget (see chap. 2). In theory the board could use this "Secretary of Defense Reserve" to shift the emphasis in research and development programs. After the Korean War started, the dramatic increase in congressional appropriations for research and development included proportionately greater amounts for the "OSD Emergency Fund" (the new name for the "Secretary of Defense Reserve"). Initially, these funds were appropriated as supplements to the FY 1951 budget and then as part of the regular annual budgets. Their disposition and the ultimate fate of the emergency fund itself demonstrate why many considered the Research and Development Board to be ineffective.

Walter G. Whitman, chairman, Research and Development Board, 1951–1953.

By the end of January 1951, Congress had appropriated $170 million for the emergency fund in supplements to the FY 1951 budget. The Research and Development Board, not having developed any formal method for distributing the money, simply approved military department requests in the order received after a brief review by the staff. Later in the year, the board's staff decided that a policy and procedure were needed for allocating the $90 million emergency fund that had been appropriated in the FY 1952 budget. (Through September 1951, only $4.1 million of the $90 million had been distributed.) After the issue was discussed at a board meeting in early October, the staff asked the military departments to provide recommendations not only on emergency fund policy and procedures but also on the appropriate size for the fund in FY 1953.[181]

The services, fearing that the Research and Development Board might become an operating organization competing with their own research and development programs, had previously demonstrated their hostility to OSD's controlling a substantial emergency fund. In its April 1951 recommendation to the secretary of defense on the size of the FY 1952 research and development budget, the board voted 6 to 1 against the chairman and requested that the emergency fund not exceed $50 million.[182] Overridden on that occasion ($90 million was eventually budgeted), the services took advantage of the opportunity presented by the October request of the board's staff to attack the emergency fund concept again.

The services thought the FY 1953 emergency fund should be small—much less than the $90 million appropriated for FY 1952. The Army was most generous, suggesting a figure between $30 and $50 million; the Air Force wanted to limit the fund to only $15 million; and the Navy to hold it to a paltry $5 million. "Any attempt to establish a reserve of money to further augment the existing service programs," declared the Air Force, "does not coincide with the purpose of an <u>emergency</u> fund and only creates unnecessary competition among the three military departments. The establishment of a reserve fund . . . will never be as satisfactory as the direct appropriation of R&D funds to the services in accordance with each service's needs and requirements." The Navy seconded this view, asserting that "None of the services has ever specifically stated that such a fund is a healthy adjunct to the Research and Development appropriations, and many planners feel that a fund of the present size interferes with planning a well-balanced program."[183]

The services prevailed. The emergency fund for FY 1953 totaled only $35 million, and $20 million of that was fenced (probably by the OSD comptroller) to support nuclear weapons tests.[184] The Research and Development Board could do little shaping of service research and development programs with what remained. Even if a much larger sum had been budgeted for FY 1953, the disbursement pattern of the $90 million appropriated in FY 1952 suggests that distribution would have been more of a balancing act than conscious direction. Of the $78.1 million in FY 1952 emergency funds distributed, approved for distribution, or awaiting action as of 6 May 1952 (within two months of the end of the fiscal year), the Army was awarded $19.8 million (25 percent); the Navy $24.5 million (31 percent); and the Air Force $22.9 million (29 percent).[185] These distributions were in line with each service's relative share of the total $1.2 billion R&D appropriation for FY 1952: Army—$364.8 million (30 percent); Navy—$425 million (34 percent); and Air Force—$425 million (34 percent).[186]

The services had eviscerated the emergency fund, but a new charter for the Research and Development Board finally gave its chairman some real power. Issued in May 1952, the charter authorized the chairman—independent of the board—to make recommendations to the secretary of defense regarding the overall funding level for the services' research and development programs and individual projects within them. Whitman had sought such authority since becoming chairman in July 1951, but chose to proceed cautiously.[187] The modifications he suggested for the FY 1953 budget involved no more than five projects totaling $10 million in any of the three service programs—modest and at best marginal adjustments.[188] It is possible that the reduction in the size of the emergency fund had been the price exacted by the services in return for independent budget authority for the Research and Development Board chairman. In any case, for Whitman, persuasion was preferable to dictation.[189]

When the services' research and development programs competed directly with each other, as with guided missiles, the Research and Development Board's ineffectiveness was especially apparent. Since 1947 it had done little to control what many viewed as unnecessary duplication in this area of weapons development. Service dominance of the board, however, was only part of the problem. In addition to the Research and Development Board, other OSD elements, including the JCS, the Munitions Board, and the Military Liaison Committee (for missiles designed for nuclear weapons delivery) were also involved in determining missile policy. Acknowledging that the existing management structure was not effective, OSD established the Guided Missiles Interdepartmental Operational Requirements Group in March 1950 to improve coordination.[190] But, after the Korean War began, pressure mounted for the missile program to receive higher-level attention. In response, in October 1950, the secretary of defense created the post of Director of Guided Missiles atop the fragmented Defense Department acquisition structure. Its first incumbent, recruited personally by President Truman, was Kaufman T. ("K. T.") Keller, chairman of the board of Chrysler Corporation.[191]

Some wanted the new guided missiles' head to be a "missile czar" who would direct a Manhattan-type project. The president had evidently left that option open, but Keller chose to leave missile development in the hands of the services. He later told a National War College audience that "the question of what kind of missiles were needed was the business of the military man and . . . the detailed administration of the programs was the prerogative and responsibility of the departments." As he saw it, his job was "to get some of these weapons out of R&D and into the hands of the fighting forces as quickly as possible."[192] Thus, rather than trying to coordinate the separate service missile programs and eliminate duplication, Keller focused on production.

Like Bedford, Keller functioned as an expediter. Working only part time (he continued to chair the Chrysler board) and accompanied by uniformed officers from his small staff, he traveled the country visiting laboratories, plants, and test facilities where missile work was under way. In consultation with service representatives and their contractors, Keller identified the most advanced missile projects and recommended that the secretary of defense approve funds for their accelerated development.[193] The secretary's approval, while formally required, was sometimes superfluous since Keller frequently visited the White House and secured President Truman's blessing before approaching Marshall or Lovett.[194]

Keller told the president that with respect to missiles, "Flying [a missile] has been more conclusively proven than hitting [a target]." To fabricate the large number of missiles necessary to perfect guidance systems, Keller pushed to establish pilot production lines that would also develop tools and manufacturing techniques essential for eventual mass production.[195] In December 1950, he recommended an initial group of projects for accelerated development—the Army's Nike and the Navy's Terrier, both surface-to-air missiles, and Sparrow, a Navy air-to-air system.[196] By January 1952, 22 programs (with more to come) had been evaluated by Keller and his staff and approved by the secretary of defense for special emphasis.[197] Although no missile had entered service by the end of the Korean War, Nike was close to becoming operational. In mid-1953, almost 400 missiles had been delivered and the first Nike battalion was scheduled for deployment in the Baltimore-Washington area later in the year.[198]

Some believed Keller never encountered a missile program he did not like. The perception was not entirely true. In June 1953, he denied the Army's request for $16 million to purchase the Regulus system, a Navy surface-to-surface missile capable of carrying nuclear warheads, which was then in an advanced stage of development. Although conceding it was primarily a "roles and missions" question, Keller, consistent with the way he had defined his job, turned the Army down because the missile was not ready to be fielded. He thought the Army could learn as much as it needed about Regulus by observing the Navy program. When the missile became a useable weapon, the Army could then purchase some of its production should that be authorized.[199] In avoiding the roles and missions controversy surrounding missiles, Keller joined a large group of senior defense officials who for years had been either unwilling or unable to resolve the issue.

To make progress in the missile field, OSD had circumvented its in-place management structure. It did the same in attempting to determine the requirements for a continental air defense system. In the fall of 1952, Chairman Whitman told Secretary Lovett that developing an adequate defense against air attack would be the nation's most important security concern over the next 5 to 10 years and that the secretary needed to become directly involved in the matter.[200] The preceding summer a study group sponsored by the Lincoln Laboratory (a federally funded research center established in 1951 that was administered by MIT) had proposed that the Defense Department construct an air defense network. It would consist of two radar early warning lines across Canada and be integrated with a completely automated fighter interceptor communications and control system. Although its recommendations were not supported by the Air Force, whose priority was strategic air offensive capabilities, the study reached the National Security Council, and the concept won the president's endorsement by the end of the year.[201]

In the meantime, Lovett had begun taking steps of his own. In November 1952, he told the Air Force to begin constructing the northernmost radar line that was under contract to General Electric. In December, he appointed a special committee of scientists and engineers from outside the department to study and make recommendations regarding the entire air defense problem. Chaired by

Mervin J. Kelly, head of Bell Telephone Laboratories, the committee issued its report in May 1953 after Lovett left office.[202]

Secretary of Defense Lovett presents certificate of appreciation to K. T. Keller, Director of the Office of Guided Missiles, January 1953. Left to right: General Bradley, Secretary Lovett, Keller, Deputy Secretary Foster, and Maj. Gen. Kenneth D. Nichols, Keller's deputy.

Why had Lovett not drawn upon the resources available in his own department, particularly from the Research and Development Board? Aside from the obvious difficulties with interservice rivalry, the board's committee structure did not lend itself to tackling complex research and development issues involving technologies from several science and engineering fields. In addition, OSD had not created any long-range planning process which compounded Lovett's problem. Prior to the Research and Development Board's dissolution in mid-1953, Whitman told the committee appointed to study the department's organization of the "imperative need for long-range integrated planning in the Department of Defense" and that during his service he had "looked in vain for good evidences of such planning."[203]

* * * * *

When rearmament began in the latter half of 1950, OSD failed to seize control. In the first place, most viewed acquisition as primarily a military department responsibility. Secondly, OSD, especially the secretary of defense, was heavily involved in formulating policy for the war in Korea and for the NATO alliance. Third, production problems did not surface immediately. When they did appear in the summer and fall of 1951, OSD's acquisition management structure proved unsuited to respond either quickly or efficiently.

Except for the office of comptroller, the military services controlled much of the management structure in OSD—the JCS, the Munitions Board, and the Research and Development Board—a position allowing them to shape acquisition policy. The JCS had plenty of power but moved in slow motion when asked to referee disputes between the services. The chairmen of the Munitions Board and the Research and Development Board lacked almost any independent power of their own and could achieve little without the cooperation of the services. Furthermore, for two-thirds of the war, none of the secretaries of defense showed any inclination to increase the authority of the board chairmen. In September 1951, when Lovett became secretary of defense, production was well behind schedule, and the president, Congress, and the mobilization control agencies were exerting considerable pressure to address the problems. In those circumstances, Lovett's reluctance to acquire more power for OSD through the board chairmen or to assert stronger control over the JCS must be explained.

For Lovett, as for Forrestal before him, "unification" (more accurately, "integration") of the armed forces was something that had to evolve; it could not be forced.[204] Lovett articulated his philosophy clearly in an appearance before Congressman Herbert Bonner's subcommittee in June 1952. Rather than as a military commander giving orders, he told the congressmen, he saw himself as the captain of team comprised of the military departments and OSD:

> That being so, it has seemed to me better to go as fast, and only as fast, as I can go without causing wide splits of opinion among the three separately administered military Departments, and to use my legal authority only when it is clear to me that one or more of the military Departments are permitting historical or other considerations to interfere with the effectiveness of the team. This course of action takes more time than issuing orders (which incidentally, can be to some extent frustrated by the technique of foot-dragging), but I am convinced that in the long run the Department of Defense will be a much more virile and effective organization than if I were continually cramming things down the throats of the military Departments.[205]

With respect to acquisition, the costs of teamwork often were a reactive posture, ad hoc and delayed responses, and halfway or temporary measures that did not disturb existing power relationships or attack the underlying causes of difficulties with research and development and with procurement.

In a letter to President Truman, written a little more than two months before his term as secretary expired, Lovett conceded that the boards were not effective and that new management arrangements would likely be required.[206] Shortly after becoming President Eisenhower's first secretary of defense, "Engine Charlie" Wilson appointed a committee headed by Nelson A. Rockefeller to study the department's organization. One of the committee's recommendations, endorsed by Wilson and submitted to Congress by Eisenhower as part of Reorganization Plan No. 6 in April 1953, was that the boards should be abolished and their functions assumed by assistant secretaries of defense more directly responsible to the secretary. Approved relatively quickly by Congress, the new structure for acquisition management went into effect on 30 June 1953.[207] It remained to be seen whether it would perform more effectively than the boards. Through the end of the Korean War, however, and despite modest incursions by OSD, the services dominated acquisition. The next four chapters explore the evolution of acquisition organization and processes in each of the military departments from 1945 through 1953.

Endnotes

1. Table 4 (Forces in Being, 1950–1952), in Walter S. Poole, *The Joint Chiefs of Staff and National Policy, 1950–1952*, 71.
2. Table 8 (Actual Force Levels of US Armed Forces: 1952–1956) and table 6 (Actual Personnel Strengths of US Armed Forces: 1952–1956), in Robert J. Watson, *The Joint Chiefs of Staff and National Policy, 1953–1954*, 84, 82.
3. Table 1 (Total Federal Outlays, FY 1945–2009), in Historical Office, Office of the Secretary of Defense, *Department of Defense Key Officials, 1947–2004*, 80; and attachment (Utilization of Military Appropriations, Fiscal Years 1946–1950) to ltr, Assistant Secretary of Defense (Comptroller) W. J. McNeil to Senator Blair Moody, 7 May 1952, folder 1953 Budget, box 6, Budget Files, FY 1953, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO.
4. Table 1 (Total Federal Outlays, FY 1945–2009), *Department of Defense Key Officials*, 80.
5. Assistant Secretary of Defense (Supply & Logistics), *Munitions Production Report*, 21 August 1953, table (Hard Goods Programs, Estimated Value of Deliveries, July 1950–June 1953), 8, folder Munitions Production Reports, box 87, entry 220 (Historical Manuscripts and Papers Containing Background Data Re: Munitions Board and Industrial Mobilization Programs, 1947–1953), RG 330.
6. In 1955, DoD's comptroller, Assistant Secretary of Defense Wilfred J. McNeil estimated the war to have cost a total of $18.1 billion for all three years. Other estimates range from $30 to $54 billion. See Doris M. Condit, *The Test of War, 1950–1953*, 509; and table 1 (Total Federal Outlays, FY 1945–2009), *Department of Defense Key Officials*, 80.
7. Paul H. Nitze, George Kennan's successor as director of the State Department's Policy Planning Staff, chaired the group.
8. Condit, *Test of War*, 5-11.
9. Ibid., 6-7; and Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 6, 27. The text of NSC 68 was first published in the *Naval War College Review* 27, no. 6 (May/June 1975): 51-108.
10. Truman had approved NSC 68 on 29 September 1950 as a statement of policy to be followed over the next four or five years. He also agreed that the rearmament program NSC 68 proposed should be put into effect as soon as possible with the understanding that specific force levels and costs would be decided once they were firmly established. See Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 31-32.
11. Condit, *Test of War*, 227-42; and Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 27-39. In September 1950, the Defense Production Act had granted the president substantial authority to increase defense production and regulate the economy. By its terms, the president could "assign priorities, allocate materials and facilities, requisition property for defense production, regulate consumer credit, make or guarantee defense production loans, negotiate

long-term contracts for scarce materials and impose wage and price controls until 30 June 1951." (Condit, 30).

12. Paul G. Pierpaoli, Jr., *Truman and Korea: The Political Culture of the Cold War*, 5, 32-33, 47, 118, 226; and Condit, *Test of War*, 30, 239, 246, 248-49.

13. Quoted in ltr, Secretary of Defense Robert A. Lovett to Senator Lyndon B. Johnson, 11 January 1952, folder Defense Department, box 12, entry 187 (Records of Clay Bedford, Special Assistant to the Secretary of Defense for Production, Relating to Policies and Procedures for Expediting Military Production Programs, 1951–52), RG 330.

14. Pierpaoli, *Truman and Korea*, 11, 46.

15. Office of Defense Mobilization, *Building America's Might: Report to the President by the Director of Defense Mobilization*, No. 1, 1 April 1951, 2; Edwin T. Gibson, Acting Administrator, Defense Production Administration, "Planning Production for Defense," address to the Industrial College of the Armed Forces, Fort Lesley McNair, Washington, D.C., 1 May 1951, 3-4, NDU Library; minutes, Defense Mobilization Board meeting no. 19, 14 November 1951, folder CD 334 (Def. Mob. Bd.) 1951, box 260, entry 199 (Confidential Through Top Secret Subject Correspondence File, 1947–1953), RG 330; and Manly Fleischmann, Administrator, Defense Production Administration, "Material Planning for Defense Production," address to the Industrial College of the Armed Forces, Fort Lesley McNair, Washington, D.C., 13 May 1952, 2-3, NDU Library.

16. Pierpaoli, *Truman and Korea*, 11.

17. For a concise, step-by-step description, see Rodolfo A. Correa, "The Organization for Defense Mobilization," *The Federal Bar Journal* 13, no. 2 (September 1952): 1-15.

18. Pierpaoli, *Truman and Korea*, 36-38, 44-45; and Condit, *Test of War*, 30. Until its dissolution in 1953, the main responsibility of the National Security Resources Board was long-term mobilization planning, including programs for civil defense. See Harry B. Yoshpe, *A Case Study in Peacetime Mobilization Planning: The National Security Resources Board, 1947–1953*.

19. Pierpaoli, *Truman and Korea*, 44.

20. Ibid., 50-51. Wilson, responsible for instituting unpopular wage and price controls, sometimes referred to "Engine Charlie" as the "good" Wilson. See House and Senate Committees on Banking and Currency and Select Committees on Small Business, *Production and Allocations: Joint Hearing before the Committees on Banking and Currency and the Select Committees on Small Business*, 82d Cong., 1st sess., 12 October 1951, 40.

21. Pierpaoli, *Truman and Korea*, 53.

22. Minutes, Defense Mobilization Board meeting no.1, 28 December 1950, folder CD 334 (Def. Mob. Bd.) 1951, box 260, entry 199, RG 330.

23. Ibid [italics added].

24. Pierpaoli, *Truman and Korea*, 53-54, 113, 138-39; and R. Cuff, "From the Controlled Materials Plan to the Defense Materials System, 1942–1953," *Military Affairs* 51, no. 1 (January 1987): 4.

25. Condit, *Test of War*, 31-37; and Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 32-33, 54.

26. The membership of the JCS changed very little during the Korean War. Gen. of the Army Omar N. Bradley, the chairman; Gen. J. Lawton Collins, Army chief of staff; and Gen. Hoyt S. Vandenberg, Air Force chief of staff, served throughout the war. In August 1951, Adm. William M. Fechteler replaced Adm. Forrest P. Sherman, who suffered a fatal heart attack, as chief of naval operations.

27. This is a simplified description of what was in reality a highly complex process. At any point in time, the Department of Defense was either planning or executing budgets for three different fiscal years.

28. Leonard Niederlehner, interview by Alfred Goldberg and Maurice Matloff, 6, 14, 19 May 1987. Addendum to interview, 5 June 1988, 7, OSD/HO.

29. Biography of John D. Small, atch to text of his "Current Objectives, Problems, and Plans

of the Munitions Board," address to the Industrial College of the Armed Forces, Fort Lesley McNair, Washington, D.C., 8 February 1952, NDU Library.

30. Department of Defense Directive 5126.5 (Munitions Board Charter), 29 July 1952, folder Munitions Board Charter, 1951, box 88, entry 221 (Records of Dr. Elliott Cassidy Accumulated While Serving as Historian and Special Assistant to the Chairman of the Munitions Board, 1948–1953), RG 330; and Condit, *Test of War*, 504-05.

31. Gibson, "Planning Production for Defense," 2.

32. Condit, *Test of War*, 227-40.

33. Ibid., 276; Pierpaoli, *Truman and Korea*, 154-59; and Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 57.

34. George A. Lincoln, "Economic Problems of Military Mobilization: Planning Military Requirements," *The American Economic Review* 42, no. 2 (May 1952): 438; Research and Development Board, "Budget and Fiscal Information on Research and Development Program, FY 1952–FY 1954," 25 September 1952, 24, folder RDB 106.7, Fiscal Year 1954, box 497, entry 341(Research and Development Board), RG 330; Richard U. Sherman, Jr., "The Formulation of Military Requirements for Munitions and Raw Materials," 127-30, 151-52; and William N. Lawrence [deputy assistant director, Production Area, Office of Defense Mobilization], "The Role of the Office of Defense Mobilization in the Determination and Use of Requirements Data," address to the Industrial College of the Armed Forces, Fort Lesley McNair, Washington, D.C., 7 December 1954, 17, NDU Library.

35. Gibson, "Planning Production for Defense," 14.

36. Senate Committee on Armed Services, Preparedness Investigating Subcommittee Forty-Third Report, *Investigation of the Preparedness Program: Interim Report on Defense Mobilization Aircraft Procurement*, 82d Cong., 2d sess., 1952, 13.

37. Memo, F. J. Lawton, Director, Bureau of the Budget, for the President, 3 November 1950, sub: The System for Translating Military End Item Requirements into Requirements for Materials, folder CD 410 (Gen.) 1950, box 209, entry 199, RG 330.

38. Memo, MSC [Col. Marshall S. Carter, executive assistant to the secretary of defense] for Mr. Lovett, General Marshall, 6 November 1950, ibid.

39. Department of Defense, Office of Public Information, Press Release 35-51, 9 January 1951, folder Munitions Board—Organization, 1948, box 949, Subject Files, OSD/HO; Munitions Board Annual Report on Management Improvement, FY 1951, 2, atch to memo, Robert M. Hatfield, Jr., Executive Assistant to the Chairman, Munitions Board, for Assistant to the Secretary of Defense for Management Engineering, 17 August 1951, sub: Munitions Board Annual Report on Management Improvement, folder Munitions Board Management Improvement Program, box 93, entry 221, RG 330; and Condit, *Test of War*, 502.

40. Analysis Branch, Plans Division, Office of Programs and Plans, "Staff Study: Analysis and Review of Military Requirements," 27 November 1950, folder Analysis and Review of Military Requirements, box 89, entry 221, RG 330.

41. Memo, J. D. Small, Chairman, Munitions Board, for Under Secretary of the Army, Assistant Secretary of the Navy, Assistant Secretary of the Air Force, 31 January 1951, sub: Mission of the Harvard Group, folder Harvard Requirements Survey Report to the Munitions Board, ibid.

42. Mobilization Analysis Center, Graduate School of Business Administration, Harvard University, *Requirements Survey Report to the Munitions Board*, Pt. I, Munitions Board, January–March 1951,1-4, box 36, entry 218 (Historical Records Relating to the Organization and Operations of the Munitions Board and to the Policies and Programs for the Procurement and Distribution of Critical Materials, 1947–1953), RG 330. Pt. II, Department of the Army; Pt. III, Department of the Navy; Pt. IV, Department of the Air Force.

43. Harry S. Truman, "Special Message to the Congress Recommending Extension and Broadening of the Defense Production Act," 26 April 1951, *Public Papers of the Presidents of the United States: Harry S. Truman, 1951*, 244-53.

44. Harry S. Truman, "Remarks to Key Officials on the Budget for the Military Functions of the Department of Defense," 27 April 1951, ibid., 257-60. Delivered on 27 April, the text of the president's remarks was released on 3 May 1951. Among those listed as present were Deputy Secretary of Defense Lovett; the three service secretaries (Secretary of the Army Frank Pace, Jr., Secretary of the Navy Francis P. Matthews, Secretary of the Air Force Thomas K. Finletter); the military department representatives on the Munitions Board (Assistant Secretary of the Army Karl R. Bendetsen, Under Secretary of the Navy Dan A. Kimball, Assistant Secretary of the Air Force Eugene M. Zuckert); the chairman (General Bradley) and members of the Joint Chiefs of Staff (Generals Collins and Vandenberg and Admiral Sherman); Munitions Board Chairman Small; Director of Defense Mobilization Wilson; Defense Production Administrator Harrison; National Production Authority Administrator Fleischmann; and Bureau of the Budget Director Lawton.
45. Truman, "Remarks to Key Officials," 27 April 1951, 258.
46. Senate Committee on Armed Services, Preparedness Investigating Subcommittee Thirty-Eighth Report, *Investigation of the Preparedness Program: Report on the Munitions Board*, 82d Cong., 2d sess., 1952, 24.
47. Truman, "Remarks to Key Officials," 27 April 1951, 258-59 (quotation, 258).
48. Memo, Acting Secretary of Defense Robert A. Lovett for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, Assistant Secretary of Defense (Comptroller), Chairman, Munitions Board, Chairman, Joint Chiefs of Staff, 1 May 1951, folder MB 639, box 133, entry 233 (Correspondence, Reports, and Index Sheets Pertaining to Agenda Items Discussed at Munitions Board Meetings, 1947–1953), RG 330.
49. Memo, W. F. Schaub, Deputy Chief, Estimates Division, for Director, Bureau of the Budget, 18 May 1951, sub: Report to the President on His Request for the Establishment of Management Controls for the Military Production Program, folder Budget FY 1952 (McNeil File), box 5, Budget Files, FY 1952, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO.
50. Memo, Acting Secretary of Defense Robert A. Lovett for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, Assistant Secretary of Defense (Comptroller), Chairman, Munitions Board, Chairman, Joint Chiefs of Staff, 31 May 1951, folder MB 639, box 133, entry 233, RG 330.
51. Office of Defense Mobilization, *The Battle for Production: Fourth Quarterly Report to the President by the Director of Defense Mobilization*, 1 January 1952, 8. The paragraph was headed: "Realistic Production Schedules Are Being Set."
52. Statement by John D. Small, House Committee on Expenditures in the Executive Departments, *Federal Supply Management (Implementation of Military Supply Regulations): Hearings before a Subcommittee of the Committee on Expenditures in the Executive Departments*, 82d Cong., 2d sess., 5 December 1952, 281.
53. Munitions Board Presentation to Management Committee (Progress on Implementing . . . the Acting Secretary of Defense's Directive of 31 May 1951), 3 August 1951, no folder, box 82, entry 220, RG 330. See also, Senate Preparedness Investigating Subcommittee, *Report on the Munitions Board*, 1952, 8-9, 24.
54. Senate Committee on Armed Services, Preparedness Investigating Subcommittee Thirty-Fifth Report, *Investigation of the Preparedness Program: Interim Report on Defense Mobilization*, 82d Cong., 1st sess., 1951, 4.
55. Assistant Secretary of Defense (Supply & Logistics), *Munitions Production Report*, 21 August 1953, table (Hard Goods Programs, Estimated Value of Deliveries, July 1950–June 1953), 8.
56. Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 48-49.
57. Assistant Secretary of Defense (Supply & Logistics), *Munitions Production Report*, 21 August 1953, table (Hard Goods Programs, Estimated Value of Deliveries, July 1950–June 1953), 8; and table 8 (FY 1952 Appropriations), in Condit, *Test of War*, 259.

58. Office of Defense Mobilization, *Battle for Production*, 6.
59. Statement by John D. Small before the Preparedness Investigating Subcommittee of the Senate Armed Services Committee with Off-the-Record Inserts, 26 May 1952, folder USAF Programs, box 33, Miscellaneous Files, 1950–1961, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO; and Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 50, citing Air Force Chief of Staff Gen. Hoyt S. Vandenberg. See also, Munitions Board, "Lead Time from $$ to Deliveries," 22 April 1952, folder Procurement Statistics, box 955, Subject Files, OSD/HO.
60. Senate Preparedness Investigating Subcommittee, *Interim Report on Defense Mobilization*, 1951, 2.
61. Munitions Board, "Progress Report on Military Materiel Programs and Stockpiling," 21 July 1951, i, folder CD 381 (War Plans NSC 68) 1951, box 272, entry 199, RG 330.
62. Atch to memo, Nathaniel Knowles, Assistant Administrator, Office of Production Analysis, National Production Authority, for William D. Pawley, Special Assistant to Secretary of Defense, 18 December 1951, sub: NPA Fact Book Article on Machine Tools, 2, in envelope marked CD 410.2, 7 July 1952, box 381, entry 199, RG 330.
63. For an interesting contemporary discussion of the application of machine tools to weapons production, see Horace Mansfield Horner, president, United Aircraft Corporation, "Jet Engine Production," address to the Industrial College of the Armed Forces, Fort Lesley McNair, Washington, D.C., 11 February 1952, NDU Library. See also Burnham Finney, "Bottleneck No. 1—Machine Tools," *New York Times Magazine*, 3 February 1952, 13, 28.
64. Statement by Secretary of Defense Robert A. Lovett before the Preparedness Investigating Subcommittee of the Senate Armed Services Committee, 20 May 1952, folder CD 334 (Armed Svcs Cmte) May–Dec. 1952, box 350, entry 199, RG 330.
65. Ltr, H. R. Boyer to John D. Small, 15 February 1952, folder Defense Production Administration, box 12, entry 187, RG 330. For other examples, see the case files in boxes 9, 10, and 11, ibid. The component was the S–3 Gyrosyn Control Unit.
66. See the following in-depth assessments of the machine tool industry: Metalworking Equipment Division, National Production Authority, "Machine Tool Situation and Outlook," 19 December 1951, atch to ltr, Henry H. Fowler, Administrator, National Production Authority, to Senator Lyndon B. Johnson, 11 January 1952, folder CD 413 1952, box 381, entry 199, RG 330; Joint Committee on Defense Production, *Defense Production Act, Progress Report No. 13: Machine Tools*, 82d Cong., 2d sess., 1952, S. Rpt. 1107; memo, Ralph S. Howe, Director, Metalworking Equipment Division, National Production Authority, for Henry H. Fowler, Administrator, National Production Authority, 5 September 1952, sub: Recommendations Concerning Problems of the Machine Tool Industry, folder Bedford, Clay P., box 12, entry 187, RG 330; "Background History of the Machine Tool Industry," preliminary draft of report for the Advisory Committee on Production Equipment (Vance Committee), 16 October 1952, and Ralph S. Howe, Special Assistant to the Defense Production Administrator, "Report to the Advisory Committee on Production Equipment, Office of Defense Mobilization, Concerning the Problems of the Machine Tool Industry," 20 October 1952: both in folder CD 334 (Def. Mob. Bd.) 1953, box 25, entry 199, RG 330. See also, "The Machine-Tool Fumble," *Fortune* 45 (January 1952): 56, 148, 150; and Harbridge House, Inc., "The OCDM Case: Requirements, Resources, and National Defense Preparedness," 10-11.
67. Office of Defense Mobilization, *Building America's Might*, 13-16; and Munitions Board, "Progress Report on Military Materiel Programs and Stockpiling," 21 July 1951, ii-iii. Chromium, cobalt, columbium, molybdenum, nickel, and tungsten, when combined (alloyed) with other metals, imparted greater hardness and resistance to high temperatures, and were vital in jet-engine production.
68. Ltr, G. C. Marshall to the President, 21 April 1951, folder CD 401.1 1951, box 283; ltr, Harry S. Truman to John D. Small, 3 May 1951, folder CD 410.2 1951, box 284; ltr, Harry S. Truman to Charles E. Wilson, 6 August 1951, folder CD 410.2, box 284;and memo, R. M.

Hatfield, Acting Chairman, Munitions Board, for Brig. Gen. Marshall S. Carter [executive assistant to the secretary of defense], 30 November 1951, sub: Munitions Board Brief for Secretary Lovett, folder CD 319.1 #1, box 255: all in entry 199, RG 330.
69. Senate Preparedness Investigating Subcommittee, *Report on the Munitions Board*, 1952, 34-36; Office of Defense Mobilization, *Building America's Might*, 12, 14-15; Pierpaoli, *Truman and Korea*, 113, 137-40; and Cuff, "Controlled Materials Plan," 3-4. Initially the Controlled Materials Plan was unlike its identically named World War II predecessor because it applied only to companies filling defense orders—a hardship on civilian economy producers who found it more difficult to get the controlled materials. In October 1951, it was extended to the latter.
70. Memo, James A. Barker, Staff Assistant, Office of Special Expediting, OSD, for Clay P. Bedford, Special Assistant to the Secretary of Defense, 16 January 1952, sub: Critical Copper Condition at AMPCO Metal Company, folder Bedford, Clay P., box 12, entry 187, RG 330.
71. Ltrs, J. D. Small to Manly Fleischmann, Administrator, Defense Production Administration, 23 January, 6 and 12 February 1952; and memo, Cdr. G. C. Wells, Chief, Office of Ships Programs, Munitions Board, for Military Director for Production and Requirements, Munitions Board, 12 February 1952, sub: The AMPCO Company: all in folder Munitions Board, box 14, entry 187, RG 330.
72. Minutes Munitions Board meeting no. 184, 31 January 1952, and meeting no. 199, 19 June 1952, box 116, entry 229, RG 330.
73. Tamara Moser Melia, *"Damn the Torpedoes": A Short History of U.S. Naval Mine Countermeasures, 1777–1991*, 73-79. When the forces finally came ashore, Maj. Gen. Edward M. Almond, the Army's X Corps commander, and Bob Hope and his USO (United Service Organizations) show were there to greet them.
74. The terms "design changes" and "engineering changes" are used interchangeably in this volume.
75. James A. Huston, *Guns and Butter, Powder and Rice: U.S. Army Logistics in the Korean War*, 170.
76. Summary of Report to President by Director of Defense Mobilization, 1 November 1951, atch to memo, J. D. Small for Secretary of Defense, 7 November 1951, folder CD 381 (Gen., folder #1) Jul. 1950 thru Dec. 1951, box 270, entry 199, RG 330.
77. Minutes, Defense Mobilization Board meeting no. 16, 12 September 1951, folder CD 334 (Def. Mob. Bd.) 1951, box 260, entry 199, RG 330; and ltr, Charles E. Wilson to Robert A. Lovett, 30 October 1951, folder ODM, box 14, entry 187, RG 330.
78. Minutes, meeting of Production Executive Committee, 20 November 1951, folder Production Executive Committee Minutes, box 258, entry 199, RG 330. Members of the committee included high-level representatives from the Defense Production Administration, the National Production Authority, the Munitions Board, and the military departments.
79. Statement by Secretary of Defense Robert A. Lovett before the Preparedness Investigating Subcommittee of the Senate Armed Services Committee, 20 May 1952, folder CD 334 (Armed Svcs Cmte) May–Dec. 1952, box 350, entry 199, RG 330; A. M. Rothrock, Assistant Director for Research, National Advisory Committee for Aeronautics, "Review of Problems of Conservation of Strategic Materials for Turbine Engines," 17; John D. Small, "Department of Defense Requirements for Critical Materials Required for Jet-Engine Production," 18-19; and Panel Discussion, 38 (the latter three were presentations at the Government-Industry Meeting Concerning Alloying Materials Required for Jet-Engine Production, Washington, D.C., 11 May 1951): all three in folder Report of the Government-Industry Meeting on Alloys Required for Jet-Engine Production, box 950, Subject Files, OSD/HO; and Research and Development Board, "Status Report on the Aeronautical Research and Development Program," 17 April 1952, 5, 7, folder 2 (RDB-AR-100), box 431, entry 341, RG 330.
80. "Background History of the Machine Tool Industry," preliminary draft of report for the Advisory Committee on Production Equipment (Vance Committee), 16 October 1952, 39.
81. Horner, "Jet Engine Production," 10.

82. Brig. Gen. Horace A. Shepard, Director of Procurement and Engineering, Headquarters, U.S. Air Force, "Current Mobilization Planning for Aircraft Production," address to the Industrial College of the Armed Forces, Fort Lesley McNair, Washington, D.C., 1 May 1950, 19, NDU Library.
83. Munitions Board, "Progress Report on Military Materiel Programs and Stockpiling," 21 July 1951, 23.
84. Ibid., 1.
85. Munitions Board, "Preliminary Report on Production Problems and Deliveries," 10 January 1952, 2-5, atch to memo, J. D. Small for Acting Secretary of Defense William C. Foster, 11 January 1952, folder CD 400.174 (Mil. Urgency) Jan. 1952, box 378, entry 199, RG 330.
86. See, for example, Munitions Board, "Preliminary Report on Deliveries of Selected Items, January 1953," 10 February 1953, table B (Preliminary Reports of Production Difficulties in January 1953), 6-7, folder Preliminary Report, Selected Items, box 87, entry 220, RG 330.
87. Mr. Buschman [Munitions Board staff], "Components," atch to "Possible Questions and Answers for Use by the Chairman, Munitions Board at Hearings Before Congressional Committees," 8 June 1951, in black binder labeled Good Management, box 83, entry 220, RG 330; minutes, Munitions Board meeting no. 174, 25 October 1951, box 116, entry 229, RG 330; and John D. Small, "Appendix A, Answers to Specific Questions Asked by the Staff of the Senate Preparedness Committee," ca. May 1952, folder Senate Preparedness Subcommittee Reports (Lyndon Johnson), box 87, entry 220, RG 330.
88. John C. Huston, Jr., Acting Chairman, Munitions Board, "Munitions Board Notes for the Secretary," 6 February 1953, folder CD 334 (Dir. of Adm. OSD) thru 334 (NSC) 1953, box 25, entry 199, RG 330. See also minutes, meeting of Production Executive Committee, 5 September 1951, folder Production Executive Committee Minutes, box 258, entry 199, RG 330.
89. Manly Fleischmann, "Coordinating Production in an Emergency," address to the Industrial College of the Armed Forces, Fort Lesley McNair, Washington, D.C., 24 February 1953, 11, NDU Library.
90. Minutes, Munitions Board meeting no. 174, 25 October 1951; draft memo, Clay P. Bedford, Special Assistant to the Secretary of Defense, for Alfred E. Howse, Chairman, Procurement Policy Board, Office of Defense Mobilization, 26 January 1952, folder ODM, box 14, entry 187, RG 330; John D. Small, "Current Objectives, Problems, and Plans of the Munitions Board," address to the Industrial College of the Armed Forces, 8 February 1952, Fort Lesley McNair, Washington, D.C., 9-10, NDU Library; and memo, Clay P. Bedford for the Deputy Secretary of Defense, 10 March 1951, sub: Comments on Anna Rosenberg's [assistant secretary of defense for manpower and personnel] Memorandum, "Sole Source Procurement," folder Bedford, Clay P., box 12, entry 187, RG 330.
91. Condit, *Test of War*, 500.
92. "Munitions Board Notes for the Secretary," 3 July 1952, folder CD 334 (Mun. Bd.) 1952, box 351, entry 199, RG 330.
93. Munitions Board Staff Report (Vice Chairman for Production and Requirements), 21 August 1952, sub: Effects of Steel Strike on Production of "S" Urgency Ammunition, folder CCS 004.04 (11-4-46), sec. 53, box 9, entry 10 (Central Decimal File, 1951–1953), RG 218.
94. Pierpaoli, *Truman and Korea*, 170-71.
95. Memo, Hatfield for Carter, 30 November 1951. The Subcommittee on Intergovernmental Relations of the House Committee on Expenditures in the Executive Departments was commonly referred to as the "Bonner Committee," after its chairman Herbert C. Bonner (D-N.C.).
96. Minutes, Defense Mobilization Board meeting no. 20, 28 November 1951, folder CD 334 (Def. Mob. Bd) 1951, box 260, entry 199, RG 330.
97. Senate Preparedness Investigating Subcommittee, *Investigation of the Preparedness Program: Interim Report on Defense Mobilization*, 1951, 16-17. With respect to machine tools, the subcommittee asserted: "We understand that while the Air Force has made its reserve available .

. . the Army and the Navy for a long period of time refused to do so. There is no excuse for such behavior occurring in a unified defense set-up with proper monitoring authority." (p. 9)

98. "Background History of the Machine Tool Industry," preliminary draft of report for the Advisory Committee on Production Equipment (Vance Committee), 16 October 1952.

99. Metalworking Equipment Division, National Production Authority, "Machine Tool Situation and Outlook," 19 December 1951, atch to ltr, Fowler to Johnson, 11 January 1952; and atch (Department of Defense Comments on Recommendations Contained in the 35th Report of the Preparedness Investigating Subcommittee, Recommendation 4) to ltr, Robert A. Lovett to Senator Lyndon B. Johnson, 11 January 1952, folder Senate Preparedness Subcommittee, 1952, box 957, Subject Files, OSD/HO.

100. Memo, H. K. Clark, Deputy for Production, Office of the Under Secretary of the Air Force, for Secretary of Defense, 29 October 1951, sub: Machine Tools in Reserve, folder Machine Tool Program, box 13, entry 187, RG 330. Clark had recently left the position of Munitions Board executive vice chairman.

101. Ltr, H. K. Clark, Deputy for Production, Office of the Under Secretary of the Air Force, to Robert A. Lovett, 29 October 1951, ibid.

102. Memo, H. K. Clark, Deputy for Production, Office of the Under Secretary of the Air Force, for Secretary of Defense, 30 November 1951, sub: Machine Tools in Reserve-HKC Memorandum 29 October 1951, ibid. At about the same time, Lovett received a letter from H. R. Boyer, deputy administrator of the Defense Production Administration, urging that machine tools in military reserves "be thrown open for inspection by master mechanics of companies assigned accredited programs." See Boyer to Lovett, 5 December 1951, ibid.

103. Ltr, Tell Berna, General Manager, National Machine Tool Builders' Association, to W. D. Pawley, Special Assistant to the Secretary of Defense, 12 December 1951, ibid.

104. Memo, William D. Pawley, Special Assistant to the Secretary of Defense, for Secretary of Defense, 28 December 1951, sub: Sources of Machine Tools and Machine Tool Capacity, ibid.

105. Memo, William C. Foster, Deputy Secretary of Defense, for Chairman, Munitions Board, 29 January 1952, sub: Acquisition and Utilization of Machine Tools, folder CD 410.2 1952, box 381, entry 199, RG 330.

106. Atch (Department of Defense Comments on Recommendations Contained in the 35th Report of the Preparedness Investigating Subcommittee, Recommendation 2) to ltr, Lovett to Johnson, 11 January 1952.

107. Memo, Clay P. Bedford, Special Assistant to the Secretary of Defense, for Mr. Lovett, 10 January 1952, sub: Expediting of Major Production Items, folder CD 470.174 (Mil. Urgency) Jan 1952, box 378, entry 199, RG 330.

108. Department of Defense Directive 360.04-2C (Special Expediting Procedure for Selected Military Production Items), 21 February 1952, folder CD 470.174 (Mil. Urgency) 1 Feb.–28 Feb. 1952, box 379, entry 199, RG 330. The programs/items were: Air Force—B/RB–47 bomber, F–86 fighter, J47 engine, APQ–24 bomb navigation system; Army—M48 medium tank with 90-mm. gun; 81-mm., 60-mm., and 4.2-inch mortar shells; 155-mm. and 105-mm. howitzer shells; 75-mm. and 57-mm. rifle shells; quartz crystal [for communications equipment]; Ford GAA engine for M4–A3 Sherman medium tank [World War II vintage tank in use in Korea]; stainless steel spiral four cable [wire for electronic equipment]; and hydrogen thyratron [gas filled electronic tube]; Navy—AD bomber [carrier-based, ground-attack], F9F fighter, J40 engine, wooden minesweeper, and 2.75-inch FFAR [folding fin, air-to-air] rocket. See also memo, Bedford for Lovett, 10 January 1952; and memos, Clay P. Bedford for Mr. Alexander [Under Secretary of the Army Archibald S. Alexander] and Clay P. Bedford for Mr. Gilpatric [Under Secretary of the Air Force Roswell L. Gilpatric]: both dated 22 January 1952 with sub: Expediting Major Military Items of Critical Military Urgency, and in folder Expediting Lists, box 12, entry 187, RG 330; and memo, Clay P. Bedford for Mr. Lovett, 13 February 1952, sub: Revision of Production Expediting Lists, folder CD 400.17, box 378, entry 199, RG 330.

109. Memo, James A. Barker, Staff Assistant, Office of Special Expediting, for Maj. Gen. Fred

R. Dent, Jr., Munitions Board, 3 June 1952, sub: Special Expediting Procedure for Selected Military Production Items, Section 7-1.7, Department of Defense Priorities and Allocation Manual; and ltr, D.C. Ramsey, President, Aircraft Industries Association of America, Inc., to Clay Bedford, 3 June 1952: both in folder Special Expediting Procedure, box 14, entry 187, RG 330.

110. Fleischmann, "Material Planning for Defense Production," 13 February 1952, 8.

111. Ltr, Ramsey to Bedford, 3 June 1952.

112. Memo, Barker for Dent, 3 June 1952. See also memo, Edwin C. Garwood, Deputy Assistant Administrator, Industrial & Agricultural Equipment Bureau, National Production Authority, for Clay P. Bedford, 26 May 1952, sub: Special Expediting Procedure, folder Special Expediting Procedure, box 14, entry 187, RG 330.

113. Memo, Garwood for Bedford, 26 May 1952; and Department of Defense Directive Transmittal, 8 April 1952, folder CD 313.3 (OSD Directive Section) 1952, box 343, entry 199, RG 330.

114. Memo, Barker for Dent, 3 June 1952.

115. Statement by Clay Bedford, House Committee on Expenditures in the Executive Departments, *Federal Supply Management*, 1 July 1952, 122.

116. Ibid., 126-27.

117. For the impact of ambitious performance requirements on postwar Air Force bomber acquisition programs, see chap. 9 in this volume, and especially Michael E. Brown, *Flying Blind: The Politics of the U.S. Strategic Bomber Program*.

118. Memo, D. F. Carpenter, Chairman, Munitions Board, for Karl T. Compton, Chairman, Research and Development Board, 28 February 1949, folder Carpenter File, February–March 1949, box 121, entry 231 (Records Maintained by the Munitions Board Chairmen, July 1947–Sept. 1950), RG 330; memo, Carpenter for Compton, 3 March 1949, folder 9 (209/RDB), box 37, entry 341, RG 330; memo, D. F. Carpenter for Ward Canaday, 19 May 1949, sub: "Simplicity and Producibility" of Designs of Military Materiel, folder Reading File (DFC) 15 May 1949–30 June 1949, box 122, entry 231, RG 330; and Research and Development Board Statement of Policy on Simplification of Design of Military Materiel, 24 June 1949, folder 14, box 39, entry 341, RG 330.

119. Memo, Lyle S. Garlock, Deputy to the Assistant Secretary of Defense (Comptroller), for Mr. Lovett, 1 May 1951, attaching msg, AFCVC [Air Force vice chief of staff] 59210, to CGAMC [commanding general, Air Materiel Command] Wright-Patterson AFB, Dayton, Ohio, 11 April 1951, sub: Freezing the Design of Current Production Aircraft, folder CD 452.01 1951, box 285, entry 199, RG 330.

120. Memo, Maj. Gen. Jerry V. Matejka, U.S. Army, Military Director for Production and Requirements, Munitions Board, for Under Secretary of the Army, Assistant Secretary of the Navy, 16 May 1951, sub: Delays in Production Due to Changes in Design, folder CCS 004.04 (11-4-46), sec. 35, box 6, entry 10, RG 218.

121. Minutes, Munitions Board meeting no. 175, 8 November 1951, box 116, entry 229, RG 330.

122. Memo, J. D. Small for Under Secretary of the Army, Under Secretary of the Navy, Under Secretary of the Air Force, 19 November 1951, sub: Delays in Production Due to Changes in Design, folder CCS 004.04 (11-4-46), sec. 35, box 6, entry 10, RG 218.

123. Memo, Dan A. Kimball, Secretary of the Navy, for Secretary of Defense, 21 November 1951, sub: Department of the Navy Budget Estimates for Fiscal Year 1953, folder Budget-1953, box 6, Budget Files, FY 1953, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO.

124. Minutes, Production Executive Committee meeting, 6 December 1951, folder Production Executive Committee, box 258, entry 199, RG 330. Research has not uncovered the "directives." It is possible that the minutes refer to directives issued by the military departments.

125. See, for example, Senate Preparedness Investigating Subcommittee, *Investigation of the Preparedness Program: Interim Report on Defense Mobilization Aircraft Procurement*, 1952, 14-17.

126. Statement by Secretary of Defense Robert A. Lovett before the Preparedness Investigating Subcommittee of the Senate Armed Services Committee, 20 May 1952; and John D. Small, "Appendix A, Answers to Specific Questions Asked by the Staff of the Senate Preparedness Committee," ca. May 1952, 30-31. See also ltr, Robert A. Lovett to Senator Lyndon B. Johnson, 6 November 1952, attaching Memorandum of Comments on Forty-Third Report of the Preparedness Investigating Subcommittee of the Committee on Armed Services, 6 November 1962, 8-11, folder Aircraft Procurement, box 955, Subject Files, OSD/HO.
127. Small, "Current Objectives, Problems, and Plans of the Munitions Board," 8 February 1952, 15.
128. Minutes of the Secretary of Defense Review of FY 1954 Budget Request, Department of the Army, 28 October 1952, 11, folder FY 1954 Budget, box 7, Budget Files, 1954, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO. He made the same point to the Air Force's leadership. See Minutes of the Secretary of Defense Review of the FY 1954 Budget Request, Department of the Air Force, 27 October 1952, 15, ibid.
129. Robert Watson-Watt, *The Pulse of Radar: The Autobiography of Sir Robert Watson-Watt*, 46.
130. Transcript of executive session of Senate Preparedness Investigating Subcommittee hearing, 23 May 1952, 64-8, folder CD 334 (Armed Svcs Cmte) May–Dec. 1952, box 350, entry 199, RG 330.
131. Department of Defense, Office of Public Information, Press Release 113-51, 22 January 1951, folder Aircraft Procurement, box 955, Subject Files, OSD/HO; and John D. Small, "Appendix A, Answers to Specific Questions Asked by the Staff of the Senate Preparedness Committee," ca. May 1952, 34.
132. Memo, R. L. Gilpatric, Assistant Secretary of the Air Force, for Assistant Secretary of the Navy John T. Koehler, 4 August 1951, sub: Aircraft Production Resources Agency (APRA); memo for record, Myron L. Tracy, Chief, Office of Aircraft Programs, Munitions Board, 20 August 1951, sub: Meeting held on 17 August 1951 Concerning the Aircraft Production Resources Agency; and memo for record, Col. Troup Miller, Jr., Director of Industrial Resources, Office, Deputy Chief of Staff, Materiel, Headquarters, U.S. Air Force, 22 August 1951, sub: Meeting, 21 August 1951, regarding the Aircraft Production Resources Agency: all in folder Aircraft Production Resources Agency (1951) 322.1, box 495, entry 327 (Munitions Board, Joint Aircraft Committee, Decimal File, 1948–1953), RG 330; memo, J. D. Small for Assistant Secretary of the Air Force (Materiel), 28 August 1951, sub: Aircraft Production Resources Agency; and memo, J. D. Small for Chairman, Defense Management Committee thru Deputy Secretary of Defense, 17 April 1952, sub: Aircraft Production Resources Agency: both in folder APRA Organization 1953 322.1, box 495, entry 327, RG 330.
133. Ltr, Charles E. Wilson to Robert A. Lovett, 30 October 1951, folder ODM, box 14, entry 187, RG 330; minutes, Defense Mobilization Board meeting no. 20, 14 November 1951, folder CD 334 (Def. Mob. Bd) 1951, box 260, entry 199, RG 330; Senate Preparedness Investigating Subcommittee, *Investigation of the Preparedness Program: Interim Report on Defense Mobilization*, 1951, 17; and Pierpaoli, *Truman and Korea*, 40, 67, 115-17.
134. Memo, G. C. Marshall for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, 18 December 1950, sub: Broadening the Industrial Base of Procurement Programs, folder Budget History, 1950–1953, box 6, Budget Files, FY 1953, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO.
135. Vice Adm. Edwin D. Foster, "Navy Procurement," address to the Industrial College of the Armed Forces, Fort Lesley McNair, Washington, D.C., 14 December 1950, 6, NDU Library.
136. Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30 1951*, 35-37; atch (Department of Defense Comments on Recommendations Contained in the 35th Report of the Preparedness Subcommittee, Recommendation 5) to ltr, Lovett to Johnson, 11 January 1952; memo, Col. Sidney N. Storbratten, Chief Special Projects Division, Production and Requirements Directorate, Munitions Board, for Colonel Tally [Munitions Board staff], 10 March 1952, Accomplishments of Production and Requirements CY 1951,

sec. Supply Management, 12, box 82, entry 220, RG 330; Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30 1952*, 35-36; and statement by Richard Lennihan, Director, Office of Small Business, Munitions Board, before the Subcommittee on Military Procurement, Senate Select Committee on Small Business, 6 May 1953, 4, folder Small Business, box 23, entry 189 (Records Accumulated by Robert W. Koch, Special Assistant to the Secretary of Defense, Relating to the Establishment of Effective Procurement Methods and Operations throughout the Department of Defense, Apr. 2–Oct. 1953), RG 330.
137. Statistics Office, Assistant Secretary of Defense of Defense (Supply & Logistics), "Military Prime Contracts with Small Business, June 1953," 7 October 1953, 7, 9, folder Military Prime Contracts, 1952–1955, box 956, Subject Files, OSD/HO; Small, "Current Objectives, Problems, and Plans of the Munitions Board," 8 February 1952, 4-5; and Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30 1952*, 36.
138. Minutes of the Secretary of Defense Review of FY 1954 Budget Request, Department of the Army, 28 October 1952, 21.
139. Munitions Board Report 3C (Analysis of Large Military Prime Contractors, July 1950–December 1952), 18 June 1953, 5-6, folder Contractors-Government, box 20, entry 189, RG 330.
140. Condit, *Test of War*, 444-51.
141. Frank C. Nash, assistant to the secretary of defense for international security affairs, wrote Lovett: "Progress toward meeting Department of Defense materiel objectives can be significantly advanced if increased reliance can be placed on off-shore procurement to meet the requirements for M.D.A.P." See memo, Nash for Lovett, 7 August 1951, folder CD 381 (War Plans NSC 114) 1951, box 272, entry 199, RG 330.
142. Condit, *Test of War*, 444-51.
143. Truman, "Remarks to Key Officials," 27 April 1951, 258.
144. Statement by Clay Bedford, House Committee on Expenditures in the Executive Departments, *Federal Supply Management*, 1 July 1952, 125-26.
145. Senate Preparedness Investigating Subcommittee, *Investigation of the Preparedness Program: Interim Report on Defense Mobilization*, 1951, 8; ltr, Fowler to Johnson, 11 January 1952; and Munitions Board Presentation to Management Committee, 3 August 1951.
146. Department of Defense Directive 360.04-6 (Plan for Establishing Relative Military Urgencies), 7 September 1951, folder CCS 004.04 (11-4-46), sec. 34, box 6, entry 10, RG 218.
147. Metalworking Equipment Division, National Production Authority, "Machine Tool Situation and Outlook," 19 December 1951, 17-18, atch to ltr, Fowler to Senator Johnson, 11 January 1952.
148. Memo, J. D. Small for Secretary of Defense, 31 October 1951, sub: Relative Military Urgencies, attaching memo, Capt. W. G. Lalor, USN, Secretary, Joint Chiefs of Staff, for Chairman, Munitions Board, 24 March 1950, sub: Relative Military Urgencies (Strategic Priorities), folder CD 400.174 (Mil. Urgency) 1951, box 282, entry 199, RG 330.
149. Memo, Robert A. Lovett for Joint Chiefs of Staff, 8 November 1951, sub: Relative Military Urgencies, ibid.
150. Ltr, C. E. Wilson, Director, Office of Defense Mobilization, to Robert A. Lovett, 23 October 1951, folder Mobilization, box 86, entry 220, RG 330.
151. Condit, *Test of War*, 270-73.
152. Memo (JCS 1725/126), Chief of Staff, U.S. Air Force [Gen. Hoyt S. Vandenberg], for the Joint Chiefs of Staff, 21 November 1951, sub: Relative Military Urgencies, folder CCS 004.04 (11-4-46), sec. 35, box 6, entry 10, RG 218. Vandenberg suggested the following priorities: "1. Prosecution of the Korean War until conclusion, 2. Defense of the United States against air-delivered atomic attack, 3. Defense of the United States against seaborne atomic attack, 4. Destruction of Soviet war sustaining resources, 5. Defense of the NATO area, 6. Defense of the Far East, 7. Defense of all other strategic areas." Priority no. 2 included: "Air operations against the Soviet atomic delivery capability at base [and] direct air defense operations against the

enemy airborne attacking force."
153. Memo (DM-189-51), Maj. Gen. C. P. Cabell, USAF, Director, Joint Staff, for General Bradley, General Vandenberg, General Collins, Admiral Fechteler, 30 November 1951, sub: Relative Military Urgencies, sec. 36, ibid. The debate over linking mission priorities to production lasted several months. The best statement of the two opposing positions is Report by the Joint Strategic Plans Committee (JCS 1725/154) to Joint Chiefs of Staff, sub: Relative Military Urgencies, 12 March 1952, sec. 41, box 7, ibid.
154. Memo, Brig. Gen. Marshall S. Carter, Director, Executive Office of the Secretary of Defense, for Joint Chiefs of Staff, 28 November 1951, sub: Relative Military Urgencies, folder CD 400.174 (Mil. Urgency) 1951, box 282, entry 199, RG 330. In addition to the secretary of defense, the other members of the Armed Forces Policy Council were the deputy secretary of defense, the three service secretaries, the JCS chairman, and the three service chiefs.
155. Ltr, Charles E. Wilson to Robert A. Lovett, 4 December 1951, ibid.
156. Memorandum for record, Cdr. L. L. Schock, Secretary, Munitions Board, 4 December 1951, sub: Joint Meeting of MB-JCS Re Relative Military Urgencies, folder MB 327/3, box 127, entry 233, RG 330. Actually there were two meetings. The three under secretaries met with the acting chairman and members of the Munitions Board staff prior to conferring with the Joint Chiefs of Staff. Wilson's letter may have been hand-carried to the Pentagon the morning of 4 December or Defense officials may have been otherwise alerted to its contents in advance of the meetings.
157. Memo, R. M. Hatfield, Acting Chairman, Munitions Board, for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, 6 December 1951, sub: Military Urgencies, folder CCS 004.04 (11-4-46), sec. 36, box 6, entry 10, RG 218.
158. Staff Brief for Presentation to Munitions Board (Item 327/4), 18 December 1951; minutes, Munitions Board meeting no. 180, 20 December 1951, with encl. 1 (Department of Defense Master Urgency List): both in folder MB 327/4, box 127, entry 233, RG 330; and memo, William C. Foster, Acting Secretary of Defense, for Joint Chiefs of Staff, 22 December 1951, sub: Military Urgencies, with encl. (Department of Defense Master Urgency List), folder CCS 004.04 (11-4-46), sec. 36, box 6, entry 10, RG 218.
159. Joint Chiefs of Staff Decision on JCS 1725/139 (Memorandum by Permanent Logistics Reviewing Committee on Military Urgencies), 11 January 1952; and memo, Permanent Logistics Reviewing Committee (JCS 1725/139) for Joint Chiefs of Staff, 10 January 1952, sub: Military Urgencies, with app. to encl. A (Department of Defense Master Urgency List): both in folder CCS 004.04 (11-4-46), sec. 38, box 7, entry 10, RG 218. The items in Category S in the order listed were Critical Ammunition for Korea (for 81-mm., 60-mm., 4.2-inch mortars; 155-mm. and 105-mm. howitzers; 75-mm. and 57-mm. rifles; and 2.75-inch FFAR rockets); quartz crystal; J47 engine; J40 engine; Ford GAA engine for M4–A3 tank; wooden minesweepers; F–86 aircraft; stainless steel spiral four cable; B/RB–47 aircraft; AD aircraft; F9F aircraft; APQ–24 bomb navigation system; medium tank, 90-mm. gun, M46–A1, M47, M48 (manufactured by Chrysler); and hydrogen thyratron. The first three items in Category 1 were: B/RB–36 aircraft; medium tank, 90-mm. gun, M46–A1, M47, M48 (manufactured by American Locomotive Company and Detroit Tank Arsenal); and minesweeping boats. The two lists were published as Department of Defense Directive 360.04-1S (Department of Defense Military Urgencies System), 18 January 1952, folder CD 470.174 (Mil. Urgency) Jan. 1952, box 378, entry 199, RG 330.
160. Joint Chiefs of Staff Decision on JCS 1725/139, 11 January 1952.
161. Memo, J. C. Houston, Jr., Acting Chairman, Munitions Board, for Secretaries of the Military Departments, Director Joint Staff [and others], 27 February 1952, sub: Progress Report on Initial Implementing Actions of the Department of Defense Urgency System [underlining in original], attaching Maj. Gen. Jerry V. Matejka, USA, Military Director for Production and Requirements, Munitions Board, "Notes on Relative Urgencies in Production," 25 February 1952, folder CCS 004.04 (11-4-46), secs. 40, 41, box 7, entry 10, RG 218.

162. Memo, Robert A. Lovett for Joint Chiefs of Staff, 3 March 1952, sub: Progress Report on Initial Implementing Actions of the Department of Defense Urgency System, in sec. 41, ibid.
163. Memo (SM-641-52), Rear Adm. W. G. Lalor, USN (Ret.), Secretary, Joint Chiefs of Staff, for General Bradley, General Vandenberg, General Collins, Admiral Fechteler, 5 March 1952, sub: Military Urgencies with encl., copy of memorandum from Deputy Secretary of Defense Foster to Joint Chiefs of Staff, dated 4 March 1952, ibid.
164. Memo, Clay P. Bedford for Secretary of Defense, 10 March 1952, sub: Revision of Department of Defense Master Urgency List, ibid. See also, memo, Clay P. Bedford for Joint Logistics Chiefs, 13 March 1952, sub: March 10 Memorandum to the Secretary of Defense Concerning Revision of Department of Defense Master Urgency List, folder Bedford, Clay P., box 12, entry 187, RG 330.
165. Memo, Robert A. Lovett for Joint Chiefs of Staff, 10 March 1952, sub: Revision of Department of Defense Master Urgencies List, folder CCS 004.04 (11-4-46), sec. 41, box 7, entry 10, RG 218.
166. Memo, Gen. Omar N. Bradley, Chairman, Joint Chiefs of Staff, for Secretary of Defense, 25 March 1952, sub: Revision of Department of Defense Master Urgency List, with encl. (Department of Defense Master Urgency List), folder CD 470.174 (Mil. Urgency) 1 Mar.–20 May 1952, box 379, entry 199, RG 330. The Category S items, in numerical order, were: ammunition (mortars)—81-mm., 60-mm., 4.2-inch; ammunition (howitzers)—155-mm., 105-mm.; ammunition (rifles)—75-mm., 57-mm.; rockets—2.75-inch FFAR; F–86 aircraft; Ford GAA engine for M4–A3 tank; AD aircraft; F9F aircraft; J47 engine; B/RB–47 aircraft; J40 engine; APQ–24 bomb navigation system; stainless steel spiral four cable; hydrogen thyratron; medium tank, 90-mm. gun, M46–A1, M47, M48; wooden minesweepers; quartz crystal. In an April revision of the Master Urgency List, the JCS stated that the relative priority numbers for Category S items “recognized requirements for the support of Korean operations.” See memo (SM-1018-52), Rear Adm. W. G. Lalor, USN (Ret.), Secretary, Joint Chiefs of Staff, for Chairman, Munitions Board, 21 April 1952, sub: Revision of the Department of Defense Master Urgency List, with encl. (Department of Defense Master Urgency List), ibid. The JCS begged off providing the military mission priority list the secretary of defense had requested in his 8 November 1951 memorandum, asserting that the Master Urgency List and close cooperation between the JCS and the Munitions Board were solving the production difficulties Lovett had outlined and that no further action was required. See memo (SM-914-52), Rear Adm. W. G. Lalor, USN (Ret.), for Director, Executive Office of the Secretary, Office of the Secretary of Defense, 9 April 1952, sub: Relative Military Urgencies, folder CCS 004.04 (11-4-46), sec. 42, box 7, entry 10, RG 218.
167. Table (Research and Development Amounts Requested of Congress and Amounts Appropriated), 9 June 1953, atch to memo, W. H. Mautz, Director, Economic and Security Estimates Division, OSD, for Gordon Nease, Senate Appropriations Committee, 11 June 1953, sub: Budget Requests and Appropriations for Research and Development, folder Revised FY 1954 Budget, box 7, Budget Files, FY 1954, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO; and table 5 (FY 1951 Appropriations), table 8 (FY 1952 Appropriations), and table 12 (FY 1953 Appropriations), in Condit, *Test of War*, 241, 259, 284.
168. Daniel J. Kevles, “K_1S_2: Korea, Science, and the State,” chap. 12 in *Big Science: The Growth of Large-scale Research*, ed. Peter Galison and Bruce Hevly, 320.
169. Research and Development Board, “Budget and Fiscal Information on Research and Development Program, FY 1952–FY 1954,” 25 September 1952, 22, folder RDB 106.7, Fiscal Year 1954, box 497, entry 341, RG 330. Its formal name was Rifle Illuminating Grenade (M–27).
170. Lori S. Tagg, *On the Front Line of R&D: Wright-Patterson Air Force Base in the Korean War, 1950–1953*, chap. 5.
171. Mark A. Olinger, “Too Late for the War: The U.S. Industrial Base and Tank Production 1950–1953,” *Armor* 106, no. 3 (May–June 1997): 15-17.

172. Marcelle Size Knaack, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems*, Vol. II, *Post–World War II Bombers*, 222; and Department of Defense Master Urgency List (Revised by the Joint Chiefs of Staff, 21 April 1952), encl. 1, Department of Defense Directive S-4410.3 (Procedures for Implementing Approved Military Urgency Determinations), 21 May 1952, folder CD 470.174 (Mil. Urgency) 30 Oct.–30 Dec. 1952, box 380, entry 199, RG 330.
173. Ltr, C. E. Wilson, Secretary of Defense, to Arthur S. Fleming, Acting Director, Office of Defense Mobilization, 2 April 1953, folder CD 400.174 (Mil. Urgency), box 39, entry 199, RG 330.
174. Research and Development Board, "Problems Related to the FY 1954 Research and Development Budget" (RDB 106.4/14), undated, but between 9 Sept.–9 Oct. 1952, folder RDB 106.7, Fiscal Year 1954, box 497, entry 341, RG 330.
175. Richard B. Rhodes, *Dark Sun: The Making of the Hydrogen Bomb*, 493-94, 510.
176. Condit, *Test of War*, 455-58. The other members of the Special Committee on Atomic Energy were the secretary of state and the chairman of the Atomic Energy Commission.
177. Directive, Research and Development Board, 14 September 1949, folder Research and Development Board, 1947–1952, box 829, Subject Files, OSD/HO.
178. Department of Defense, Office of Public Information, Press Release 328-50, 14 March 1950, folder RDB Personnel, ibid.; and James Reston, "Truman Asks Utility Leader to Head Top Research Body," *New York Times,* 1 February 1950, 1.
179. Eric A. Walker, *Annual Report of the Executive Secretary*, Research and Development Board, 31 December 1950, v, 1, folder 7, box 25, entry 341, RG 330; and memo (RDB 228/9), William Webster for Chairmen, RDB Committees, 26 January 1951, sub: Orientation of RDB to Meet Current Situation, folder 15, box 39, entry 341, RG 330.
180. William Webster, office memorandum no. 18-51, 13 July 1951, sub: Appointment of Chairman, folder 3, box 583, entry 341, RG 330.
181. Agenda (RDB 106/7), RDB meeting no. 42, 26 September 1951, item 4 (Emergency Fund Policy and Procedure); and memo, James A. Perkins, Deputy Chairman, Research and Development Board, for Members, RDB, 3 October 1951, sub: Emergency Fund Policy and Procedure: both in folder 3 (RDB 106.5, Fiscal Year 1952), box 495, entry 341, RG 330.
182. Memo, William Webster, Chairman, Research and Development Board, for Secretary of Defense (Comptroller), 4 April 1951, FY 1952 Research and Development Budget, ibid.
183. Department of the Army (RDB 106/11), "Material for Discussion in Connection with RDB Questions on Emergency Fund Policies and Procedures," undated, but ca. 15 October 1952; memo (RDB 106/13), Maj. Gen. D. L. Putt, Acting Deputy Chief of Staff, Development, Headquarters, U.S. Air Force, for Chairman, Research and Development Board, 15 October 1951, sub: OSD Emergency Funds [underlining in original]; and memo (RDB 106/12), John F. Floberg, Assistant Secretary of the Navy, and Rear Adm. M. E. Curtis [Navy members, RDB], for Chairman, Research and Development Board, 17 October 1951, sub: Emergency Fund Policy and Procedure: all ibid.
184. Memo (RDB 106.3/48), Walter G. Whitman, Chairman, Research and Development Board, for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, 9 February 1953, sub: Requests for Allocation of Funds from the FY 1953 Secretary of Defense Emergency Fund, folder 2 (RDB 106.6, Fiscal Year 1953 #2), box 497, entry 341, RG 330; and memo (RDB 106.3/54), Walter G. Whitman for Members, RDB, 5 February 1953, sub: Operation CASTLE, folder 2 (RDB 106.6, Fiscal Year 1953 #2), box 497, entry 341, RG 330. The Research and Development Board staff did not think the emergency fund should be used to support nuclear weapons tests. See memo, F. J. Sette, Deputy Director, Resources Division, RDB, for Members of the IPG [Internal Policy Group, RDB staff], 4 September 1952, sub: Budgeting for Selected Joint Research and Development Activities in FY 1954, folder RDB 106.7, Fiscal Year 1954, box 497, entry 341, RG 330. Chairman Whitman recommended $35 million for the emergency fund for FY 1954. See memo (RDB 106.4/16), Walter G. Whitman for Secretary of Defense, 9 October 1952, sub: Research and Development Budget for FY 1954, ibid.

185. RDB 106.2/129, Status of Requests for Allocations from OSD Emergency Fund, FY 1952 as of 6 May 1952, 6 May 1952, folder RDB 106.5 FY 1952 #3, box 496, entry 341, RG 330. Most of the remainder of the $78.1 million ($10.5 million) had been allocated to support nuclear weapons tests.
186. Budget Division, OSD, table (Department of Defense New Obligational Authority by Cost Category, FY 1952), 1 May 1951, folder Budget FY 1952 (McNeil File), box 5, Budget Files, 1952, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO.
187. Condit, *Test of War*, 508; and memo, Walter G. Whitman for Secretary of Defense, 23 January 1953, folder 1 (RDB 117-1953), box 583, entry 341, RG 330.
188. Memo, Walter G. Whitman for Secretary of Army, sub: FY 1953 Army Research and Development Program; memo, for Secretary of the Navy, sub: FY 1953 Navy Research and Development Program; and memo, for Secretary of the Air Force, sub: FY 1953 Air Force Research and Development Program: each dated 27 June 1952, in folder RDB 106.6 Fiscal Year 1953, box 497, entry 341, RG 330. For the Air Force reply, acquiescing in the recommendations, see memo, Thomas K. Finletter, Secretary of the Air Force, for Chairman, Research and Development Board, 2 September 1952, ibid.
189. Walter G. Whitman, "Scientific Research and National Security," presentation at Department of Defense Joint Civilian Orientation Conference, Pentagon, Washington, D.C., 14 November 1952, 10, folder 2 (Joint Civilian Orientation Conference), box 514, entry 341, RG 330; and Walter G. Whitman, testimony before Committee on Department of Defense Organization [Rockefeller Committee], 16, 21 March 1953, folder Whitman, box 520, Subject Files, OSD/HO.
190. Jacob Neufeld, *Ballistic Missiles in the United States Air Force, 1945–1960*, 79.
191. Condit, *Test of War*, 473-75; and Herbert F. York and G. Allen Greb, "Military Research and Development: A Postwar History," *Bulletin of the Atomic Scientists* 33 (January 1977): 18-20.
192. Text, "Mr. K. T. Keller's Talk Before National War College on February 10, 1953," folder CD 470 1953, box 41, entry 199, RG 330; and ltr, Maj. Gen. Kenneth D. Nichols, USA, Deputy Director of Guided Missiles, to Senator George Smathers, folder Keller Period, 1950–1953, box 844, Subject Files, OSD/HO.
193. Ltr, K. T. Keller to the President, 10 July 1951, attaching "Report to the President on Status of Guided Missiles, 10 July 1951," encl. to memo, Maj. Gen. K. D. Nichols, USA, for Deputy Secretary of Defense, 12 July 1951, folder ODGM Misc Papers 1950–1953, box 844, Subject Files, OSD/HO; K. T. Keller, "Final Report of the Director of Guided Missiles," 17 September 1953 (located in brown folder labeled "This Book the Property of Mr. A. G. Waggoner"), ibid.; and K. D. Nichols, interview by Doris M. Condit, Pentagon, Washington, D.C., 17 April 1984, 33-35, OSD/HO.
194. Nichols interview, 32-33.
195. Ltr, Keller to the President, 10 July 1951; and Keller, "Final Report of the Director of Guided Missiles," 17 September 1953. Quotation is from Keller ltr, 10 July 1951.
196. Memo, K. T. Keller, Director of Guided Missiles, for Secretary of Defense, 14 December 1950, folder 470 1950, box 209, entry 199, RG 330.
197. Memo, K. T. Keller, Director of Guided Missiles, for Chairman, Research and Development Board, 9 January 1952, sub: Evaluation of Guided Missile Projects, folder CD 470 (Jan.–30 June) 1952, box 385, entry 199, RG 330.
198. Assistant Secretary of Defense (Supply & Logistics), *Munitions Production Report*, 21 August 1953, table (NIKE, XSAM), 62; and memo, Walter G. Whitman, Chairman, Research and Development Board, for Deputy Secretary of Defense [Roger M. Kyes], 16 March 1953, sub: Summary of Major Research and Development Projects, folder RDB 106.5 FY 1952 #3, box 496, entry 341, RG 330.
199. Memo, K. T. Keller, Director of Guided Missiles, for Secretary of Defense, 26 June 1953, sub: Army Procurement of Regulus Guided Missiles, folder CD 470 1953, box 41, entry 199,

RG 330; and Watson, *Joint Chiefs of Staff and National Policy, 1953–1954*, 181.
200. Walter G. Whitman, “Statement for Committee on Department of Defense Organization,” 1, 19 March 1953, folder Whitman, box 520, Subject Files, OSD/HO.
201. Richard M. Leighton, *Strategy, Money, and the New Look*, 116-17.
202. Ibid.
203. Walter G. Whitman, “Statement for Committee on Department of Defense Organization,” 1, 19 March 1953.
204. See Rearden, *Formative Years*, 36-37, 539; and Condit, *Test of War*, 37, 527, 531, for this interpretation.
205. Statement by Robert A. Lovett, House Committee on Expenditures in the Executive Departments, *Federal Supply Management (Air Force Supply-Munitions Board): Hearings before a Subcommittee of the Committee on Expenditures in the Executive Departments*, 82d Cong., 2d sess., 24 June 1952, 4.
206. For the text of Lovett’s letter to the president, see “Secretary Lovett’s Letter—18 November 1952,” in *The Department of Defense: Documents on Establishment and Organization, 1944–1978*, 115-26.
207. For the Rockefeller Committee report and Reorganization Plan No. 6 of 1953, see “The Rockefeller Committee—11 February–11 April 1953,” 126-49, and “Reorganization Plan No. 6 of 1953,” 157-58, ibid.; and chap. 8 in this volume.

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II. Sources: News Release, OD-SB (5-29-51), No. 33, 29 May 1951, Executive Office of the President, Office of Defense Mobilization; statement by Clay Bedford, House Committee on Expenditures in the Executive Departments, Federal Supply Management (*Air Force Supply-Munitions Board): Hearings before a Subcommittee of the Committee on Expenditures in the Executive Departments*, 82d Cong., 2d sess., 1 July 1952, 107; Frederic C. Lane et al., *Ships for Victory: A History of Shipbuilding Under the U.S. Maritime Commission in World War II,* 54 (*Fortune* quotation), 238 (Bedford quotation); “Clay Patrick Bedford,” Rensselaer Polytechnic Institute, Alumni Hall of Fame, http://www.rpi.edu/about/alumni/inductees/bedford.html; and Bedford obituary (Clay P. Bedford, 88, Executive In Top Projects at Kaiser Industries), *New York Times*, 31 October 1991.

CHAPTER IV

Mission and Materiel: The Army and Acquisition, 1945–1953

At the annual commanders' conference on 7 June 1950, officers from the General Staff reported to the Army's top civilian and uniformed leaders on the service's readiness for emergency mobilization. The outlook was gloomy. Lt. Gen. Thomas B. Larkin, assistant chief of staff for logistics (G–4), stated that the Army lacked modern materiel: "Had war occurred this morning we would have to wage it for a long period with our World War II equipment. Much of this is verging on obsolescence. Most of it requires extensive repair and overhaul. . . ." Furthermore, the officers from G–4 indicated that the service had not made satisfactory progress in developing the technologically advanced weapons needed to counter larger and better equipped Soviet forces. Maj. Gen. Ward H. Maris, who headed research and development and worked for Larkin, told the group: "The situation with respect to R&D is not good. In the light of preventing the over-running of Western Europe by the well recognized qualitative[ly] and quantitative[ly] superior Russian armor it is, indeed, dangerous." Maris attributed the deficiencies in developing new weapon systems to limited funding in previous years.[1]

Less than three weeks later, the North Korean invasion of South Korea, followed before the end of the year by Communist Chinese intervention in the conflict, ended the fiscal drought. By December 1950, when President Truman declared a national emergency, Congress had already added nearly $12 billion to the previously approved $13 billion FY 1951 Defense budget.[2] Between July 1950 and June 1953, the Army alone received over $19 billion for procurement and over $1 billion for research and development to fight the war in Korea and to achieve the force levels set out in NSC 68, the administration's policy paper calling for a large-scale and rapid U.S. military buildup.[3]

On the eve of the war, Major General Maris blamed shortcomings in research and development on insufficient funds. But more important, a decentralized and fragmented structure for research and development had resulted in a program lacking firm direction and clear purpose and unable to adjust quickly or easily to changes in the Army's mission. Although the Army sought to address these weaknesses in the early 1950s, the outcome was a compromise that failed to solve the problems. Ironically, the infusion of funds for research and development may have made the Army less inclined to deal forcefully with the deficiencies in its organization for acquisition.

The rearmament itself did not go smoothly. Some of the difficulties were beyond the Army's control, an inevitable consequence of the size and pace of the effort. Others resulted from the Army's failure initially to provide realistic requirements estimates and delivery schedules, and from its decision to rush new systems into production before they had been thoroughly tested.

THE ARMY, 1945–1953: AN OVERVIEW

In 1945, the U.S. Army, triumphant over its World War II adversaries, almost immediately began a precipitous and debilitating demobilization. In early 1948, General of the Army Dwight D. Eisenhower, Army chief of staff, described the consequences of the drawdown: "By no stretch of the facts can the United States Army, as it is now manned, deployed, and engaged, be considered an offensive force."[4] But by 1953, beginning with a modest buildup in FY 1949 followed by a rapid expansion after the start of the Korean War, the Army had not only recovered personnel and materiel strength but had also gained a new mission as the linchpin for the ground defense of Western Europe against Soviet attack.


General of the Army Dwight D. Eisenhower, chief of staff, U.S. Army, 1945–1948.
Courtesy, U.S. Army Center of Military History.

Changes in personnel totals, the number of major combat units, and the annual budget illustrate the Army's roller-coaster-like decline and recovery from 1945 through 1953. At its peak in World War II, the Army, including the Army Air Forces (AAF), numbered over 8 million personnel and deployed 89 full-strength ground combat divisions. By mid-1947 that force had declined to under one million, 684,000 in the Army and 306,000 in the AAF. In 1948, the regular Army, now shorn of the Army Air Forces, reached its postwar low of 538,000. Force increases the next year raised Army strength to 651,000, but, after budget cuts by the Truman administration, the higher level was not sustained.[5] By June 1950, the Army had declined again to 591,000 personnel, comprising 10 divisions, 12 separate regiments, and 48 antiaircraft battalions, nearly all under their authorized strengths.[6] At that time, the Army's projected FY 1951 budget, as approved by the House of Representatives in May 1950 (the Senate not acting until after the Korean War started), was just under $4 billion. This amount was 30 percent of the House-approved Department of Defense budget, a percentage about equal to the Navy's share, but considerably smaller than that granted to the Air Force.[7] After the start of the Korean War, the Army began expanding rapidly. By 1953, it was two and a half times its prewar size—over 1.5 million troops, 20 divisions, 18 separate regiments, and 114 antiaircraft artillery battalions.[8] Its FY 1953 budget of $13.2 billion was more than three times that originally planned for FY 1951 and 28 percent of total Defense Department appropriations, somewhat more than the Navy's slice but well below the Air Force's almost 40 percent.[9]

ARMY ACTIVE FORCES
FY 1947–FY 1953

FY	1947	1948	1949	1950	1951	1952	1953
Divisions [1]	12 (12R)	11 (11R)	10 (10R)	10 (9R)	17 (3R)	19 (5R)	19
Regiments [1]	19 (19R)	9 (9R)	11 (11R)	12 (11R)	18 (10R)	18 (13R)	18
Personnel [2]	685	554	660	593	1,532	1,596	1,534

1. R = Reduced strength. Table reflects Army divisions that were technically active on 30 June of the fiscal year. Thus, on 30 June 1947, the 3d Infantry Division numbered 164 personnel, and on 30 June 1948, 28 personnel.
2. Personnel figures (in thousands).

The Air Force's primacy in military appropriations reflected strategic air power's preeminence in national security strategy. Indeed, after World War II, the increasing U.S. reliance on nuclear weapons and air forces to deliver them seemed to throw into question whether the Army would have any meaningful role in countering the threat posed by the Soviet Union and communism.[10] Compared to the Air Force's carrying out of the strategic air offensive, the Army's postwar tasks lacked glamour. Among them were occupying defeated Germany and Japan, garrisoning overseas bases (some essential to supporting the air offensive), maintaining a mobile strike force that might be deployed to trouble spots abroad, and providing antiaircraft defense of vital locations within the United States such as the nation's capital, the locks between Lake Superior and Lake Huron at Sault Ste. Marie, and the Hanford plutonium production plant in the state of Washington.[11]

Reaffirmation of the Army's importance came in the Korean War and in its new mission—the ground defense of Western Europe—that resulted from the North Atlantic Treaty, signed by the United States in April 1949. In Korea, Army forces bore the brunt of the fighting; six of its divisions and one Marine division were holding the line when the war ended in July 1953. In Europe, by the end of 1951, the Army had increased its strength from one to five divisions.[12]

That the Army would play a vital role in Western Europe's defense was clear even before the 4th Infantry, the first of the additional divisions to be deployed to the continent, sailed from New York in May 1951. Before the end of 1950, the 7th Army had been activated in Germany and General Eisenhower, who had retired in 1948, was recalled to active duty and appointed the Supreme Allied Commander, Europe, a position comparable to the one he held in World War II.[13] At the same time, but unknown to the public, war planning by the Joint Chiefs of Staff began to reflect expanded tasks for Army forces in Europe. Until the fall of 1950, JCS plans for a war between the United States and the Soviet Union conceded that Soviet armies would likely overrun the continent. Army forces then in Europe were to withdraw beyond the Pyrenees Mountains on the Franco-Spanish border and to establish bases in North Africa and the United Kingdom. But in November 1950, with the buildup to meet NSC 68 force levels under way, the JCS approved a plan based on the assumptions of a war beginning in July 1953 and an increase in NATO forces. It called for defending "as far east as possible" and withdrawing no farther west than a line formed by the Rhine River and the Italian Alps.[14] The U.S. Army divisions headed for Europe would be crucial to such a defense.

Both in its composition and tactical doctrine, the Army that fought in Korea and stood guard in Germany closely mirrored the force that prevailed on European battlefields in World War II. The infantry dominated. Of the Army's 10 divisions in June 1950, 7 were infantry, 2 airborne, and 1 an armored division.[15] At the peak of its expansion in 1952, the Army counted 16 infantry divisions, 2 airborne divisions, but only 1 additional armored division.[16] With respect to its doctrine (accepted methods of fighting), the Army was committed to the primacy of the offensive, undertaken, as in World War II, with large-scale, carefully coordinated combined arms operations (infantry, armor, and artillery, supported by tactical air forces) employing maximum firepower and mobility. With the exception of mobility, which began to diminish in importance, these concepts remained essential features of the Army's doctrine through the end of the Korean War. Stemming from the reliance on ever-increasing amounts of firepower delivered from static positions characteristic of the attrition warfare in Korea, mobility's doctrinal decline would have long-term effects, but in the short term was of no immediate consequence for the Army.[17]

Before the end of the Korean War, the potential effect that nuclear weapons might have on warfare had little influence on Army structure and doctrine. Initially, some doubted that the atomic bomb would ever have any tactical application. Indeed, before 1950, the size, weight, yields, and limited numbers of atomic bombs in the U.S. arsenal seemed to preclude their delivery by anything other than large aircraft and to restrict them to strategic use. But, as advances in technology made it possible to manufacture smaller devices with lower yields, the tactical employment of nuclear weapons, delivered by aircraft, guns, rockets, or missiles, became practical.[18]

By 1949, the Army had begun seriously to consider the implications of nuclear weapons for ground warfare, but progress was slow. In the fall of 1951, the Army's vice chief of staff finally approved Field Manual 100-31 (Tactical Use of Atomic Weapons) for publication and distribution throughout the Army.[19] It proclaimed that use of "tactical atomic missiles" did not require any fundamental changes in either the Army's basic offensive or defensive doctrines.[20] At about the same time, the Army began to incorporate the play of nuclear weapons into its exercises and maneuvers.[21]

Although the Army had programs for marrying nuclear warheads to missiles and rockets, the first tactical nuclear weapon to become available was the 280-mm. gun. Approved for development by the secretary of the Army in July 1950, the "Atomic Annie" was an outgrowth of the 240-mm. gun that the Ordnance Department had been working on since 1944. In May 1953, the 280-mm. gun successfully fired the first-ever atomic shell. The Army soon after shipped several of the weapons to Europe.[22] After the Korean War, as rockets and missiles equipped with nuclear warheads entered the inventory, the Army revised its tactical doctrine, introducing a new combat formation, the "pentomic division," to meet the demands of the nuclear battlefield (see chap. 11).

First test of U.S. Army's atomic cannon, Nevada, May 1953.

ORGANIZATION FOR ACQUISITION

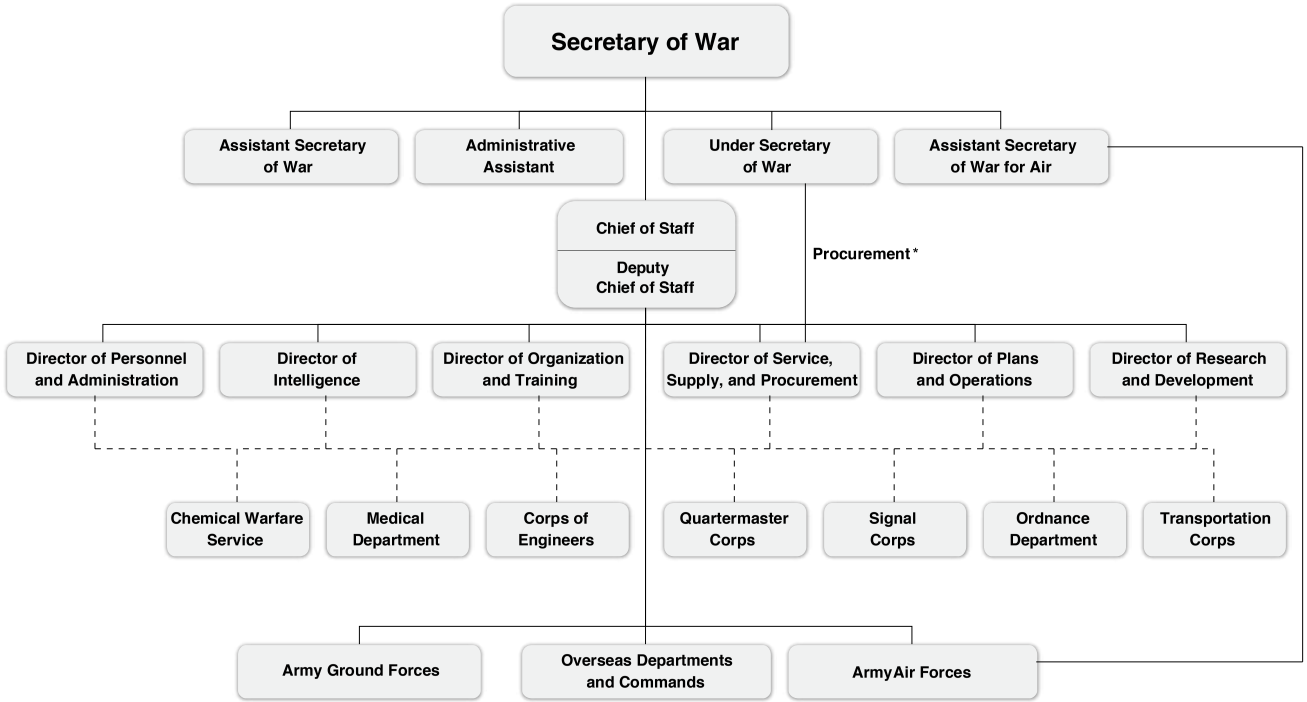
Except for changes at headquarters, the Army's organizational structure for acquiring new weapons such as the "Atomic Annie" exhibited considerable stability from 1946 to 1953. It had taken shape in a major reorganization carried out in the spring of 1946 under General Eisenhower, who succeeded General of the Army George C. Marshall as chief of staff. A key feature of the reorganization was to restore the War Department General Staff (the Army staff after September 1947) to its prewar configuration of more or less equal functional divisions. During World War II, the Operations Division had dwarfed the other staff elements, taking over many of their responsibilities. In June 1946, when the reorganization went into effect, the General Staff divisions were Personnel and Administration; Intelligence; Organization and Training; Service, Supply, and Procurement; Plans and Operations (later Operations); and Research and Development. The Service, Supply, and Procurement Division was the lineal descendant of the Army's traditional logistics staff element, G–4. The Research and Development Division was new, having been established by General Eisenhower in advance of the June reorganization.[23]

G–4 had been especially overshadowed during the war, not only losing some of its functions to the Operations Division but the vast majority to the Army Service Forces. The Army Services Forces, initially called the Services of Supply, had been created in 1942 to manage the Army's huge wartime logistics effort and was organizationally separate from the headquarters staff. The 1946 reorganization abolished the Army Service Forces, returning G–4 to its former status in the Army hierarchy but under a different name, the Service, Supply, and Procurement Division.[24]

Through the end of 1947, the Service, Supply, and Procurement Division shared acquisition responsibilities at Army headquarters with the Research and Development Division. Over the winter of 1947–1948, however, the Service, Supply, and Procurement Division absorbed the Research and Development Division and was renamed the Logistics Division. Headed by a director of logistics, the division assumed principal responsibility on the Army staff for acquisition. Then, in 1950, the Logistics Division was reorganized as the Office of the Assistant Chief of Staff for Logistics (G–4), the same designation held by that staff element during World War II.[25]

Acting on behalf of the chief of staff and under the authority of the secretary of the Army, the director of logistics (later the assistant chief of staff for logistics) was to "plan, direct, coordinate, and supervise" acquisition, but leave program operation to the Army's seven technical services: the Quartermaster Corps, the Corps of Engineers, the Medical Department (later Medical Service), the Ordnance Department (the Ordnance Corps beginning in 1950), the Signal Corps, the Chemical Warfare Service (later Chemical Corps), and

WAR DEPARTMENT
June 1946



*Supervision over procurement and industrial matters.

- - - - - - - - - Policy

Source: Adapted from Chart 14 (Organization of the War Department, 11 June 1946), in Hewes, *From Root to McNamara,* 159.

the Transportation Corps.[26] In addition to revitalizing the former G–4, the dissolution of the Army Service Forces in 1946 also returned the technical services to their visible and nearly autonomous role in Army acquisition. In World War II, their separate identities had been obscured and their influence diminished by their subordination to the Army Service Forces. In the postwar Army, the technical services once again dealt directly and separately with the Army staff, primarily G–4 but also the other functional staff elements.[27]

To one extent or another, each of the technical services carried out research and development (including test and evaluation), procurement, production, supply, and even maintenance functions for the products or commodities under its jurisdiction.[28] With respect to the acquisition of major weapons and other systems, the Ordnance Corps, the Chemical Corps, and the Signal Corps were the most important. Among the three, as measured by percentage share of the Army's research and development and procurement funds, the Ordnance Corps was the giant. It had acquisition responsibility for tanks, other armored vehicles, trucks, artillery, rockets and guided missiles, automatic weapons, small arms, ammunition, and explosives such as bombs and mines. In 1952, the Ordnance Corps operated nearly 100 field installations, including 8 arsenals and armories, 34 plants, and 3 proving grounds.[29]

An important source of technical service autonomy lay in the nature and method of appropriation of the Army's budget. Until FY 1952, Congress appropriated funds, not in bulk to the secretary of the Army, but in chunks to the service's major organizational elements. Furthermore, only Congress could approve transfers of funds between them. This system weakened the ability of the Army's top civilian leadership or the Army staff to exercise effective control over the technical services. Amendments to the National Security Act of 1949 strengthened Army headquarters' authority. Beginning with the FY 1952 budget, the legislation required the Army, as well as the other services, to prepare budgets based upon what it cost to perform particular functions. In the Army budget, these functions were personnel, operations and maintenance, procurement and production, and research and development. Congress appropriated funds in these functional categories directly to the secretary of the Army, who distributed them to major organizational elements. Implementation of functional "performance" budgeting diminished the independence of the technical services.[30]

In addition to G–4 and the technical services, the Army Ground Forces was a powerful force in Army acquisition. The 1946 reorganization had dissolved the Army Service Forces, but the Army Ground Forces and the Army Air Forces survived. The functions of the Army Ground Forces in the postwar Army were to develop tactical doctrine, operate much of the service's school system, and conduct field training for units stationed in the United States. In the acquisition process, the Army Ground Forces (renamed the Army Field Forces in 1948) represented the combat arms—infantry, armor, artillery—the "users" of new weapons and other systems. It established the need ("requirement") for and the desired performance characteristics of new systems, thus initiating their development. It also validated requirements for systems under development or already fielded and carried out extensive testing programs, essentially determining when a new item was ready for standard issue to Army units. As in World War II, the Army Ground Forces/Army Field Forces resisted pressures to rush systems into the field before they were thoroughly tested.[31]

From 1946 through 1953, the Army struggled to solve significant and persistent problems involving its organization for acquisition. One problem was the organization's decentralized and fragmented character, made especially troublesome because of the autonomy of the technical services. Another was the inherent overlap and confusion that arose as a functionally organized Army staff sought to direct the product-oriented technical services.[32] Although G–4 was nominally in charge of the technical services, the latter worked directly with the other Army staff divisions on nonlogistics issues such as personnel or training. Still a third difficulty involved disagreement within the Army over the appropriate place for research and development in the organizational structure. In this respect, the Army faced a dilemma: how to give research and development sufficient independence so that it would not be subordinated to procurement and production (as had occurred during World War II) but without, at the same time, erecting barriers to achieving effective coordination and integration of all logistics functions in the acquisition process. All of these problems contributed to the stress experienced by the Army's acquisition system as the service sought to meet the demands of Korea and its new role in European defense.

RESEARCH AND DEVELOPMENT

In the spring of 1947, two events symbolized one army's passing into history and another's emerging to face the future. Toward the end of March, the under secretary of war wrote the director of the Bureau of the Budget that because there was no longer a military requirement, the Army had decided to terminate its horse-breeding program.[33] Two months later, on 22 May 1947, the Army successfully fired the first U.S. ballistic missile, the Corporal E, a surface-to-surface guided missile.[34] Despite this achievement, the image of the post–World War II Army drawn by some scholars has not been that of a forward-looking military service receptive to technological innovation, but of a tradition-bound institution, slow to part with old, even outdated instruments of warfare like horses, and, at least for the initial postwar decades, lagging well behind the other services in employing new weapons technologies.[35] This portrait is false.

After World War II, the Army, like the Air Force and Navy, sought to exploit science and technology for weapons that could maintain superiority over the Soviet Union and Communist China, the likely U.S. opponents and believed to possess overwhelming numerical advantages in manpower and equipment.[36]

The Army may not have always matched the other services in developing advanced weapons, but this was not because it was indifferent to the benefits derived from science and technology. One reason the Army sometimes came up short was that it was usually last on the totem pole in appropriations for research and development. But more important, the Army failed to create an effective organizational structure and process for research and development, particularly at the policy level.

Scope of the Research and Development Effort

The Army that emerged from World War II, no less than the other services, acknowledged science's importance to military strength. A board of officers, convened during the war to recommend equipment for the postwar force, stated: "Research must be prosecuted purposely and vigorously in the post war period, if we are to recognize a technical superiority over our future enemies at the beginning of the next war."[37] In an April 1946 memorandum for the Army's top officers, General Eisenhower, the chief of staff, emphasized how vital it was for the service to draw on the nation's scientific and technical talent, a resource that had "contributed techniques and weapons which enabled us to outwit and overwhelm the enemy" in the war just ended.[38] In fact, War Department policy held that "[r]esearch and development programs in the peacetime period will be placed in the highest priority."[39]

The Army's commitment to research and development after World War II can be measured in several ways. Congressional appropriations are one yardstick. In the fiscal years 1947 through 1953, the Army received a total of $1.6 billion for research and development, an average of $117 million annually during the lean years, FYs 1947–1950, but more than triple that, an average of $380 million per year, when funding expanded during FYs 1951–1953.[40] In contrast, in FY 1940, the War Department had spent only $12.5 million on research and development, with the Army Air Forces receiving more than two-thirds of the total.[41]

Although the Army's post–World War II appropriations for research and development may have substantially exceeded prewar amounts, they were still consistently smaller than the R&D funds received by the other services. From FY 1947 through FY 1953, the Army averaged just over 24 percent of the total military establishment appropriation for research and development. In fact, in fiscal years 1949, 1950, and 1951 (as projected before the Korean War budget supplements increased the FY 1951 appropriation), the Army's share dropped below 20 percent with the Navy and Air Force dividing the remainder about equally.[42] In FY 1949, the Bureau of the Budget decided each service's percentage. But beginning with the FY 1950 budget, the Office of the Secretary of Defense, working through the Research and Development Board, which coordinated the services' programs in these areas, determined the distribution. Army officials protested what they viewed as a limitation arbitrarily based on previous budgets without consideration of the service's requirements. Reacting to the 20-40-40 percentage division for FY 1950, Secretary of the Army Kenneth C. Royall complained to Secretary of Defense James Forrestal in September 1948: "This allocation appears to be based upon past practice rather than upon an analysis of the missions of our armed forces and Soviet capabilities."[43] Five days before the outbreak of the Korean War, Major General Maris, who headed research and development in the Office of the Assistant Chief of Staff for Logistics, wrote Under Secretary of the Army Archibald S. Alexander that "the dominant factor adversely affecting the Army R&D effort was money and its allocation among the services by DoD (20-40-40)."[44] When purse strings loosened after June 1950, the Army's percentage climbed to nearly 28 percent in both FY 1952 and FY 1953.[45]

The percentage of its own budget that the Army devoted to research and development is another indication of the value that it placed on that function. In most of the fiscal years 1947 through 1953, the Army allocated a smaller percentage of its budget to research and development than the other services, about 2 percent compared to the 3 to 7 percent normally spent by the Navy and Air Force. But in fiscal years 1951 through 1953, the gap was much smaller. In those three years, the Army averaged 2.1 percent annually, the Air Force 2.4 percent, and the Navy 3.6 percent. In fact, in FY 1953, the Army outpaced the supposedly much more technologically oriented Air Force—almost 3.5 percent to 2.8 percent.[46]

In addition to funding, another measure of the Army's interest in research and development is the number of people engaged in these activities. Although the service's overall strength declined during the years prior to the Korean War, the total of its active-force military and civilian personnel involved in research and development rose steadily: 13,468 in FY 1947, 15,542 in FY 1948, and 18,758 in FY 1949.[47] In the latter year, the Ordnance Department, the Chemical Corps, and the Signal Corps together accounted for more than two-thirds of the total, with Ordnance Department personnel alone numbering over 7,000.[48]

To supplement the scientific and technical personnel available in the active force, the Army also drew on one of its components, the organized reserve. In May 1948, the Army initiated the Organized Reserve Research and Development Group program under which reserve officers who were scientists and engineers in civilian life worked on research and development projects assigned by the technical services. By the end of 1949, 2,700 reserve officers in 98 units were working on 500 research projects.[49]

Much of the Army's research and development program exploited scientific and technical resources not available within the service. In the summer of 1948, under a contract with Johns Hopkins University, the Army established the Operations Research Office (initially called the General Research Office).[50] First located at Fort Lesley J. McNair in Washington, D.C., the Army's Operations

Research Office had a permanent staff of approximately 90 in 1949, about half professional and the remainder administrative support personnel. Among its projects that year were studies of new antitank mines and minelaying methods, the tactical use of nuclear weapons, and antiaircraft systems.[51] With the outbreak of the Korean War, Operations Research Office scientists deployed overseas to undertake on-the-spot analyses of combat operations.[52]

Although G–4 oversaw the work of the Operations Research Office, the technical services initiated and supervised the remainder of the Army's research and development contracts. In FY 1952, 37 percent of Army R&D funds went to industrial contractors and 7 percent to colleges, universities, or other nonprofit institutions. The Army spent the remaining 56 percent in its own or other government facilities.[53]

The Army employed outside resources in other ways. In addition to in-house and contract personnel, it tapped the expertise available from scientists, engineers, and industrialists who sat on a large number of advisory boards and committees or acted as individual consultants. In August 1946, General Eisenhower recommended to Secretary of War Robert Patterson that a panel of "elder statesmen" from science and industry be organized to advise the War Department. Patterson quickly approved formation of the War Department (later Army) Research Advisory Panel.[54] The technical services copied this initiative. By 1951, they were sponsoring 6 advisory boards and 35 advisory committees totaling approximately 630 members. Some of the most prominent names in American science and industry served on these bodies or as individual consultants. Members of the Research Advisory Panel at Army headquarters included Karl Compton, the second chairman of the Research and Development Board and president of the Massachusetts Institute of Technology; Lee DuBridge, president of the California Institute of Technology (Caltech); Benjamin F. Fairless, president of the U.S. Steel Corporation; and Dr. J. Robert Oppenheimer, technical director of the Manhattan Project in World War II. Vannevar Bush, the first chairman of the Research and Development Board, was a member of the Ordnance Advisory Board and an informal consultant to Lt. Gen. Thomas B. Larkin, the Army's assistant chief of staff for logistics. Nobel laureate Irving Langmuir of General Electric was a consultant to the Signal Corps; J. M. Symes, vice president of the Pennsylvania Railroad, served on the board of the Transportation Corps; and H. F. Johnstone, head of the Department of Chemical Engineering at the University of Illinois, advised the Chemical Corps.[55]

A star-studded membership, however, was not an indication of a particular advisory group's effectiveness or influence. By 1948, as described later in the chapter, the Research Advisory Panel was barely functioning. Detailed studies have not been made, but the situation in the technical services may have been better. In early 1951, one of the divisions in G–4 on the Army staff reported that the advisory committee to the Ordnance Corps Ballistics Research Laboratory at the Aberdeen Proving Ground worked "shoulder to shoulder with the . . . staff at the bench."[56]

The aggregate of scientific and technical personnel available to the Army—active force, reserve component, and contract resources—pursued a large number and wide variety of research and development projects. In FY 1948, the Army's research and development program included 3,000 individual projects. After FY 1948, the number of projects began to drop steadily: to 2,476 in FY 1949, 2,196 in FY 1951, and approximately 2,000 in FY 1953.[57] The decline was not a reflection of a loss of enthusiasm for research and development, since the lowest points occurred during the fiscal years FY 1951 through FY 1953 when funding more than tripled, but was more likely an indication of attempts to impart discipline and direction to a highly active and diverse research and development program.[58]

Research and Development Adrift

General Eisenhower's 30 April 1946 charge to the Army's leadership to make full use of the nation's scientific and technical resources seemed to indicate that research and development would have high standing in the postwar Army. The day before issuing the memorandum and in advance of the major reorganization that would be implemented in June, Eisenhower took a major step toward enhancing the function's importance by directing the establishment of the Research and Development Division on the War Department General Staff with the same organizational status as the other five divisions, including the Service, Supply, and Procurement Division.[59]

Assigning responsibility for coordinating and directing research and development to a headquarters staff element, separate from and equal to the others, represented not only an affirmation of research and development's significance but also a victory for those who wanted to pry it away from procurement and production. To some, one lesson of World War II was that research and development came off second best when part of the same organization also managing other acquisition functions. Vannevar Bush was a strong proponent of this view. In testimony to the House Military Affairs Committee soon after the war, he stated:

> Basically research and procurement are incompatible. New developments are upsetting to procurement standards and procurement schedules. A procurement group is under the constant urge to regularize and standardize, particularly when funds are limited. Its primary function is to produce a sufficient supply of standard weapons for field use. Procurement units are judged, therefore, by production standards.
>
> Research, however, is the exploration of the unknown. It is speculative. It cannot be standardized. It succeeds, moreover, in virtually direct proportion to its freedom from performance controls, production pressures and traditional approaches.[60]

Eisenhower agreed with Bush and declared the need for separation in his April 1946 memorandum.

Other Army leaders held the same opinion. In January 1946, Lt. Gen. J. Lawton Collins, director of information on the General Staff but previously chief of staff of the Army Ground Forces, had recommended the two functions be separated because of the tendency for "users" in the combat arms to be more concerned about current problems rather than the future.[61] On the other hand, Lt. Gen. W. H. Simpson, president of the board of officers that made recommendations leading to the June 1946 reorganization, disagreed. "Procurement and research," he wrote Eisenhower in February, "must go hand in hand if the latter is to pay dividends." He further stated that the board he chaired "does not concur in the idea that [research] has no connection with production."[62] Although advocates of separation recognized that a relationship must be maintained between the two, many, like Simpson, believed that any geographic or organizational separation would hinder innovation and slow development. Eisenhower, seeking to allay the concerns of those who opposed separation, acknowledged that a gap would open between the scientist or technologist and the user, but argued that it could be closed "by field experimentation with equipment still in the development stage."[63]

General J. Lawton Collins, chief of staff, U.S. Army, 1949–1953.
Courtesy, U.S. Army Center of Military History.

Along with the establishment of the Research and Development Division on the General Staff, the formation of the War Department Research Advisory Panel was another Eisenhower initiative. As originally conceived, the panel members were not ordinarily to meet as a group but to be consulted individually. In this respect, the Army at first would employ a much different approach to the operation of its highest-level scientific advisory body than that adopted by the other services whose groups held formal meetings and had permanent secretariats.[64]

Creation of the Research and Development Division and the Research Advisory Panel appeared to guarantee considerable influence for research and development in Army policy formation. But those who sought this objective were soon disappointed. In December 1947, as noted earlier, the Research and Development Division was dissolved, its functions taken over by the Service, Supply, and Procurement Division (soon to be renamed the Logistics Division). The move has been explained in several ways. A department press release claimed that the reorganization was intended to reduce the number of staff elements reporting directly to the chief of staff and to adjust to the loss of the Army Air Forces research and development program, since September 1947 the responsibility of the newly independent Air Force.[65] Later, the secretary of the Army reported that a separate Research and Development Division was no longer necessary because of the close relationship between its activities and those of the Logistics Division; its absorption by the latter would ensure "integration of operational details."[66] But three years later, Lt. Gen. Henry S. Aurand, chief of the Research Division at the time of the reorganization who had then moved laterally to take over the Logistics Division, offered another explanation. He pointed to conflicts that arose between the two divisions over supervision of the technical services as a factor making the change desirable.[67] Even though a coup may not have been engineered by those who wanted a merger, the effect was the same—research and development lost its separate existence on the Army staff and once again became, organizationally, a subdivision of "logistics."

By 1948, the Research Advisory Panel, also designed to increase science and technology's influence at the top of the postwar Army, was essentially inactive. As mentioned previously, although the 10-member group included some of the nation's most distinguished leaders in science and industry, the Army had made little use of it. Various reports sent to Assistant Secretary of the Army Gordon Gray, and Maj. Gen. Anthony McAuliffe, who became head of research and development after its incorporation in the Logistics Division, indicated that the Research and Development Division had not employed the panel effectively. In one such report, an officer on the Army staff who had been involved in the panel's formation stated that it had failed thus far to "produce any worth-while results." Informed that the Air Force and Navy were making good use of their advisory groups, Gray remarked that "we seem to be remiss in this field." Despite this admission, the Army still did not put the panel to work, and it went into limbo, although never officially dissolved. It would be reborn as the Army Scientific Advisory Panel late in 1951.[68]

The transfer of oversight responsibility from the Research and Development Division to the Logistics Division did not mean that the Army's weapons development philosophy had changed. In the spring of 1946, the War Department Equipment Board (usually called the Stilwell Board after its president, General Joseph W. Stilwell) stated that the Army should follow two parallel courses in this area: "vigorous research and development of the new or anticipated types of equipment, and continued improvement of existing equipment as an interim measure."[69] Army officials repeatedly reaffirmed this two-track strategy before the start of the Korean War.[70] In a briefing on the Army's research and development program to Deputy Secretary of Defense Robert Lovett on 20 October 1950, Major General Maris stated: "During the period since the close of World War II, the Army's R&D effort has been divided generally into two parts. One, a program leading to improvement of existing weapons and equipment, and the other to a program comprising new weapons, munitions and equipment."[71]

Determining the balance of effort between the two approaches to weapons development in a program that numbered between 2,000 and 3,000 projects involving hundreds of individual items is at best an estimate, but most emphasis appears to have been on coming up with the new as opposed to improving the old. That's how Lieutenant General Aurand, then director of the Research and Development Division, characterized the Army's program to an audience at the Industrial College of the Armed Forces in November 1947.[72] Six months later, replying to a letter from Secretary Royall, who had expressed concern about the apparent lack of progress in the Army's missile program, Aurand reiterated the philosophy, stating that although the six missiles then under development could be put into production "in a relatively short time," the Army should continue its long-term approach: "to develop missiles of great accuracy and long range, rather than to produce interim weapons similar to the [World War II German] V–2 with minor improvements."[73]

Limited funds were a practical reason for the Army's focus on designing a selected number of new systems. The cost of purchasing major weapons, whether entirely new or upgraded older models, to outfit a 10-division Army would have quickly exceeded money available for procurement. At the same time, given the pace of technological advance, quantity procurement risked the possibility that systems would soon become obsolete. Thus it made more sense to emphasize developing the new over improving the old. Even then, prototypes were expensive and few could be manufactured. For example, despite work begun in 1944, the Army had only one prototype of the 240-mm. gun in the fall of 1950. It had cost $1.3 million (of the $123 million initially budgeted for research and development for FY 1951). When first fired in October 1950, the gun's trunnions broke.[74]

Unable to manufacture many prototypes of major systems, the Army sought to put itself in a favorable posture should money become available by developing and thoroughly testing advanced subsystems and components. For example, Major General Maris told Deputy Secretary of Defense Lovett in October 1950 that the Army's tank program was "economically designed on a long-range basis to assure the development of component automotive parts, guns, fire control and communication equipment which could be assembled into appropriate families of tanks and associated vehicles by developing agencies, field force boards and troop units." The Army had taken the same approach in designing a new service-wide communication system.[75]

In keeping with the strategy of concentrating more on developing prototypes of new systems—or at least their subsystems—rather than upgrading the current inventory, the Army staff provided guidance to the technical services on the weapons and equipment that would be needed in the future. It relied on several sources to formulate this program direction. These included the War

Department Equipment Board Report of 1946 (not revised until 1950); occasional strategic assessments from the Plans and Operations Division (G–3) on the Army staff; requests for weapons and equipment with particular characteristics from the Army Field Forces; and, beginning in the spring of 1948, the Research and Development Board's Master Plan for Research and Development.[76]

Issued to the technical services as an annual program for research and development, the Army staff's guidance was broad and general. "Because of the flexibility required in the Department of the Army research and development program to meet changing situations," declared one Logistics Division paper, "the objectives and areas of emphasis are expressed in general terms to permit the heads of the developing agencies to exercise fully their initiative and specialized knowledge."[77] Furthermore, the program was usually organized by commodities, such as tanks or artillery, rather than in terms of military problem areas, such as the ground defense of Western Europe, for which specific weapon systems or other equipment should be developed.[78] The result was a wide-ranging and diffuse research and development effort. In March 1948, a Logistics Division staff officer expressed dissatisfaction with this approach, asserting that "our problem is to put a lot of money on a few race horses rather than putting two dollars on nags all over the country, hoping a few will come in."[79]

The Research and Development Board's Master Plan provided guidance that should have helped focus the Army's program. It identified 18 warfare categories each containing numerous technical objectives, most often in the form of types of weapons or other systems to be developed. The Master Plan also indicated development priorities for the technical objectives, attaching an "importance" rating for each that was based on evaluations made by the JCS, the Research and Development Board, and the military departments (see chap. 2).

Despite its potential for sharpening the focus of the Army's research and development program, the Master Plan's influence was limited. First of all, it was not binding because the Army was not required to follow the plan's recommendations. Second, as most of the Army representatives on the Research and Development Board committees and panels that drew up the Master Plan came from the technical services, the document naturally reflected their commodity orientation, not necessarily Army mission requirements.[80]

After the first Master Plan (the interim plan of April 1948) was published, the Army began organizing its research and development projects according to the plan's warfare categories. That breakdown shows clearly the diffuse nature of Army research and development. In the FY 1949 program, three Master Plan categories accounted for almost 58 percent of Army R&D funds and 1,061 of the 2,476 total projects: Land Combat (24.3 percent, 682 projects), Supporting Research (22.5 percent, 283 projects), and Air Defense (11 percent, 96 projects). If the catchall category Supporting Research is excluded, the other two represented only about one-third of the effort both in terms of allocated funds and number of projects—the remaining two-thirds was spread among all the other warfare categories. Land Combat, presumably the Army's raison d'être, was only one-fourth of the program.[81]

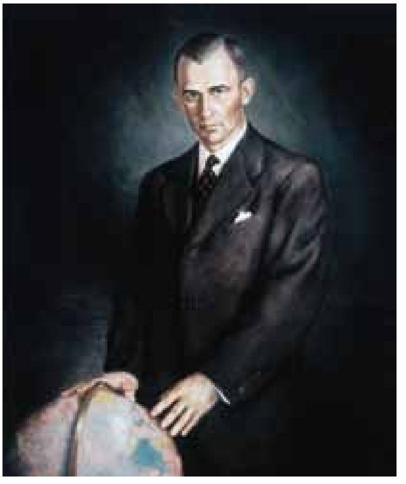
By 1950, despite funding limits, the Army had fashioned a vigorous but diffuse research and development program. Its lack of focus in part reflected the absence of a clear-cut and compelling mission for the Army. But the undisciplined program also stemmed from the Army staff's failure to provide strong guidance to the technical services, long accustomed to independence in this area in any case. Without such firm direction, the Army's research and development program lacked coherent purpose. Concerned that research and development did not have the appropriate emphasis and influenced by leaders of the scientific community, such as Vannevar Bush, the Army's top civilian leadership intervened to influence its content and organization before the outbreak of the Korean War.

Redirection and Reorganization

In the spring of 1950, the Army figured more prominently in national security strategy than at any time since the end of World War II. First, U.S. membership in NATO indicated that the Army might play a more active role on the ground in Europe; this possibility began to influence weapons acquisition planning. In June 1949, for example, the director of plans and operations on the Army staff informed General Omar Bradley, who had succeeded Eisenhower as chief of staff, that "increasing commitments to hold in Europe" in the event of war with the Soviets had established a requirement for a short-to-medium range guided missile with an atomic warhead suitable for employment against concentrations of troops and supplies."[82] Early in 1950, even though adequate forces were not then available, the JCS began work on a plan that when approved in December (following the decision to meet NSC 68's rearmament objectives) called for defending in Europe "as far east as possible." Second, along with the increased possibility of large-scale ground combat, the Army's air defense role assumed more urgency and importance. Toward the end of 1949, following detonation of the first Soviet atomic bomb, the JCS gave higher research and development priority to measures to defend the United States against an air attack.[83]

But even as the Army's defense responsibilities were expanding, Secretary of the Army Gordon Gray questioned whether his service was giving research and development sufficient organizational emphasis to prepare itself for "a war of the foreseeable future" in which the United States would have to depend on weapons of superior quality to overcome the manpower advantages of its opponents.[84] In the spring of 1950, he tasked a group of the Army's highest-level civilian and uniformed leaders, led by Under Secretary Tracy S. Voorhees and assisted by Vannevar Bush, to investigate what might be needed to enable ground forces to halt a Soviet armored advance on the continent.[85]

The study group's report was submitted to the new secretary of the Army, Frank Pace, Jr., on 19 April 1950 (Secretary Gray having become the special assistant to the president on foreign economic policy). The report concluded that the Army must take action in a number of areas to hold its position in Europe against the Soviets. These measures included obtaining adequate tactical air support and airlift from the Air Force, exploiting the potential of unconventional and psychological warfare, and modernizing the Army's World War II weapons and making them available to U.S. allies in Europe under the Mutual Defense Assistance Program. First and foremost, the Army must also accelerate certain of its research and development projects.[86]



Frank Pace, Jr., secretary of the Army, 1950–1953.
Courtesy, U.S. Army Center of Military History.

Antitank weapons were high on the list. Among these were improved mines and minelaying capabilities, and lightweight, recoilless guns firing ammunition of such penetrating power that could, in Bush's words, "render the heavy tank an obsolete weapon." Even so, the group also urged that the Army tank program be pushed forward, with periodic review in light of advances in antitank weaponry. Additionally, the report noted that a 280-mm. artillery piece, which could fire an atomic projectile 15 miles, could quickly be constructed by converting the prototype of the 240-mm. gun. Finally, the group thought more resources should be devoted to developing antiaircraft and short-range surface-to-surface missiles as well as chemical, biological, and radiological weapons.[87]

The study group cited several advantages of the weapons it had surveyed. Many were cheap compared to other systems. For this reason, they would provide "greatly increased strength <u>with unexpected economy</u>," making it possible to establish a European ground defense more rapidly. Another plus was their "inherently defensive" nature. A defense that was based on these weapons would not be seen as an "offensive threat" in contrast to expanding "strategic bombing" capabilities. "This consideration is important," claimed the study group, "because current thinking recognizes the danger that making ourselves strong may itself tend to trigger-off the very Russian attack which it seeks to avert."[88]

As well as putting the spotlight on research and development, the report was noteworthy for other reasons. First, it reflected the natural desire within the Army to find a vital role for itself in national military strategy. Second, the emphasis on defensive weapons was in accord with the hope of many scientists for an alternative to an all-out air offensive employing nuclear weapons.[89] Third, the prospect of relatively cheap but effective weaponry would appeal especially to Pace, who before becoming Army secretary had been director of the Bureau of the Budget and the Truman administration's chief cost-cutter. Finally, the report's recommendation that the tank program should also be accelerated indicated the tank's importance to the Army, notwithstanding the potential of antitank weapons stressed by Bush. Tanks were central to the infantry division's combat power, especially the division's ability to take the offensive. Furthermore, the prevailing Army view, in part a reflection of the perceived poor performance of U.S. antitank guns and lightly armored tank destroyers in World War II, was that the best way to stop a tank was with another tank.[90]

In response to the concerns expressed in the report, the Army moved to modify its FY 1951 research and development program, initially asking Congress to permit the transfer of $24 million from funds originally slated for procurement to add to the $106 million already approved for research and development. G–4's Research and Development Division projected that the additional money would be sufficient to ensure that the Army's antiarmor and surface-to-surface guided missile projects made satisfactory progress by the end of the fiscal year.[91]

The start of the Korean War and the subsequent approval of the force levels recommended in NSC 68 rapidly filled the Army's research and development purse, making it possible for much larger sums to be applied to the program's realignment. In short order, supplements to the Army's FY 1951 budget nearly tripled R&D funding to over $300 million. As was usual, the Ordnance Corps received the lion's share (over 60 percent) with Ordnance, the Signal Corps, and the Chemical Corps together accounting for 85 percent. But a significant change from past patterns had taken place with respect to the apportionment of funds among the warfare categories of the Research and Development Board's Master Plan. In FY 1949, as noted above, only about 25 percent of the R&D appropriation went to Land Combat Operations. In FY 1951, in contrast, the Army allocated $118 million for that category—almost 40 percent of its total R&D budget and a sign that the service had begun to prepare for possible ground combat in Europe. Together, the combined Land Combat and Air Defense categories exceeded 50 percent of the budget, whereas in FY 1949, the two received only one-third of the total.[92]

In another departure from past practice, the guidance in the Army's Research and Development Program for FY 1951 was more focused. Reflecting the prospect that the Army might have to confront numerically superior Soviet forces on the ground in Europe and the thrust of the report of Secretary Gray's study group, it underlined the importance of work on defensive systems. "Current strategic and operational plans," stated an annex prepared for the document by G–3, "impose a requirement for priority of emphasis in the research and development field . . . which will improve the capability of our Army to maintain itself on the defense in the face of overwhelming odds in men and equipment."[93]

Given the large number of individual research and development projects in FY 1951 (nearly 2,200) and the difficulty of distinguishing between a "defensive" as opposed to an "offensive" system, precisely how much R&D funding went to improving defensive capabilities cannot be determined. One indication, however, is that, of the 24 projects assigned the highest priority rating, the largest single amount (over $4 million) was for development of antitank ammunition for recoilless rifles.[94] In subsequent years, the Army continued its commitment to developing systems falling in the Research and Development Board Master Plan's Land Combat Operations category—almost 40 percent of the research and development program in both FY 1952 and FY 1953. In these two years as well, Land Combat and Air Defense together accounted for over half.[95]

The three fiscal years spanning the Korean War were a period of relative plenty for Army research and development—a total of $1.14 billion appropriated for FYs 1951–1953 against $469 million for the four fiscal years from 1947 through 1950.[96] Consequently, fewer difficult choices had to be made among projects competing for funds. Lack of money, then, became less of a worry of those who sought more emphasis on research and development. But before June 1950, they were also concerned that the Army's organization for research and development was not properly structured either to design a coherent and purposeful program or to give the technical services firm direction for carrying it out.

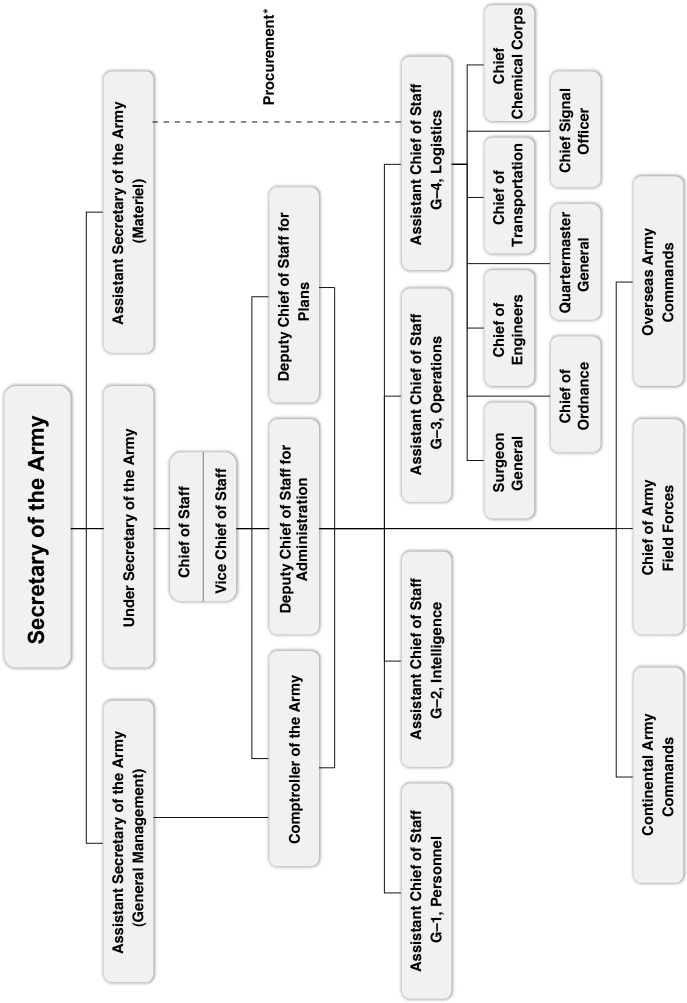
Vannevar Bush, the Gray study group's principal consultant, was among those convinced that the Army's research and development organization was badly flawed. On 24 April 1950, shortly after the report on ground defense in Europe was submitted to Secretary of the Army Pace, Bush forwarded his views on the service's R&D organization to Under Secretary Voorhees. He said that the very fact that the study group had been assembled demonstrated a belief that the task could not have been performed in a timely way by "the regular organizational machinery." To strengthen that organization, Bush made two principal recommendations: first, separate the management of research and development from procurement and give it equal status on the Army staff; and second, appoint an assistant secretary with a background in science to oversee research and development on behalf of the secretary.[97]

Bush's letter was likely the catalyst for a debate within the Army over its organization for research and development that would last for a year and a half. A month after Bush sent his letter, Assistant Secretary Archibald Alexander replaced Voorhees as under secretary. Just two days after starting his new job, Alexander wrote a memo to Secretary Pace describing the current R&D organization and outlining Bush's and other proposals for change. He stated that both former Under Secretary Voorhees and Assistant Secretary of the Army for General Management Karl R. Bendetsen agreed with removing management of research and development from G–4 and putting it on a par with the other staff divisions, but they recommended leaving oversight responsibility with the under secretary as at present. In contrast to their views, Assistant Secretary Alexander defended the current setup, suggesting only one change—a scientist of national reputation be invited to participate in periodic reviews of the Army's research and development program. He expressed strong support for the position, upheld by those who opposed dividing management of acquisition at the policy level, that research and development, procurement, and the supply system were integral phases of one process. "Provided the user's interest is well taken care of, and research itself is not fettered by an unimaginative, horse-drawn Army psychology in G–4," Alexander maintained, "research and development are so closely allied to production, procurement and industrial mobilization that I think they should be handled together by the top materiel man on the General Staff." The best way to ensure a forward-looking program, he argued, was for an aggressive and imaginative officer to occupy the deputy for research and development post in G–4.[98]

Secretary Pace, faced with significant disagreement between his key civilian subordinates, Under Secretary Alexander on one side and Assistant Secretary Bendetsen on the other, agreed to the latter's suggestion that the Army's organization for research and development be formally evaluated. The assessment, initiated in August 1950, took place under Bendetsen's general supervision with the ensuing report largely written by a civilian from the Army comptroller's office.[99]

Submitted to Pace in January 1951, the "Report on Organization and Administration of the Army Research and Development Program" was highly critical of the system for top-level management of research and development. The study found that the Army's program, instead of being designed to address a series of requirements growing out of military problems related to the service's missions, reflected the commodity orientation of the technical services. Moreover, the Army staff passively reviewed and approved the separate technical service submissions rather than aggressively formulating, coordinating, and evaluating an Army-wide program to be executed by the developing agencies. Although the technical services received policy direction in the form of the Research and Development Board's Master Plan, the Army Equipment Development Guide, G–3 strategic assessments, and Army Field Forces statements of weapon requirements and performance characteristics, they routinely composed much of it themselves. Indeed, representatives of the technical services constituted most of the Army's membership on the committees that drew up the Research and Development Board's Master Plan and assigned importance ratings to its technical objectives. Technical service personnel were also the key witnesses before the board that revised the Army Equipment Development Guide in 1950 (referred to as the "Bible" by the Army Field Forces). In the Army research and development program, declared the report, "the dominant role played by the technical services is apparent."[100]

DEPARTMENT OF THE ARMY
April 1950



* Supervision over procurement procedures and contracts.

Source: Adapted from Chart 18 (Organization of the Department of the Army, 11 April 1950), in Hewes, *From Root to McNamara*, 206-07.

The report recommended numerous changes to strengthen management by the Army secretariat and the Army staff, to move research and development further in the direction of integrated materiel solutions to mission-related problems as opposed to a myriad of independently developed commodities, and to enhance the program's prestige in the Army and with the scientific community. The most important recommendation was to remove the Research and Development Division from G–4 and place it under a new assistant chief of staff who would be on a par with the other four assistant chiefs. Above that level, the report also called for creation of a third deputy chief of staff—a deputy chief of staff for development—who would "provide over-all supervision and lend additional emphasis" to research and development. (The two positions already established were the deputy chief of staff for administration and the deputy chief of staff for plans.) Another key recommendation was to establish a Research Advisory Board with membership comparable to the now moribund Research Advisory Panel. The board would act as a body instead of its members being consulted individually, would have a supporting secretariat, and would concentrate on "broad problems of the management of research and development" rather than the narrow technical issues considered by the former panel.[101]

Prior to taking action on the report, Secretary Pace, who indicated he was favorably impressed with its conclusions and recommendations, asked Army Chief of Staff General Collins for his views.[102] Before replying, Collins circulated the study to his staff. Although concurring with much of the report, almost every staff element—especially but not surprisingly G–4—opposed its two major organizational changes: removing research and development from G–4 and locating it under a fifth assistant chief of staff, and, above that level, creating a deputy chief of staff for development.[103] General Collins echoed the staff consensus in his response to Secretary Pace, repeating many of the points made to him by G–4. He emphasized the advantage of having the technical services report to one headquarters staff agency for research and development and for procurement. The present organization would be especially effective now, he told Pace, because in response to NSC 68's rearmament goals, the Army was accelerating the fielding of new weapons, and those "production models in many cases must be modified by further development in order to be battleworthy."[104] In short, close collaboration between developers and producers, facilitated by their colocation organizationally, was more important then ever.

Following General Collins' assessment, Under Secretary Alexander added his own voice to those opposing the proposed changes.[105] The Army's top leadership was now severely divided over the question of separating the management of research and development from procurement. Bendetsen, certainly, and Pace, apparently, favored a separate staff status for research and development; Under Secretary Alexander, General Collins, and most of the Army staff, stood against the change. Although approving the balance of the report's recommendations, including a new scientific advisory board, Pace deferred decision (pending further study) on the two most controversial proposals—an assistant chief of staff for research and development and a deputy chief of staff for development.[106]

Early in the fall of 1951, the Army staff began working on a compromise that Secretary Pace approved in late December. The resulting structure, however, left management of Army research and development more fragmented and nearly as weak in relation to the technical services as before. Rather than adding a deputy chief of staff for development who would oversee R&D for the Army directly below the chief of staff, the reorganization simply changed the title of the existing deputy chief of staff for plans to deputy chief of staff for plans and research, with the added responsibility of ensuring that the research and development program conformed to JCS strategic planning and Army tactical doctrine. Nor did the compromise provide for the relocation of research and development from G–4 and its reconstitution as a separate staff division headed by an assistant chief of staff. Instead, the reorganization established the position of chief of research and development in the Office of the Chief of Staff. Its incumbent, a general officer assisted by a civilian scientist as deputy, would take over the responsibility for the Army's research and development program formerly held by G–4, personally advising the chief of staff and controlling the R&D budget. With respect to day-to-day matters, the chief of research and development would report to the deputy chief of staff for plans and research. Finally, under the new structure, all four assistant chiefs of staff would play a role in R&D program development and oversight. G–4 would retain its Research and Development Division (albeit reduced in size and responsibility) and supervisory role over the technical services; G–1 (Personnel), G–2 (Intelligence), and G–3 (Operations) would each establish a section for reviewing research and development matters falling within its purview. Some were sharply critical of this aspect of the reorganization. Major General McAuliffe, then chief of the Chemical Corps who supported a separate staff agency for research and development, called parceling out the function among several staff elements "a screwy idea."[107]

Although approving the reorganization plan, Secretary Pace considered it an initial step.[108] How it functioned over time would reveal whether the Army should move further in the direction of separating management responsibility for research and development from procurement and production. In the year following implementation of the compromise, officers in G–4's Research and Development Division indicated that it was not working and expressed support for a separate organizational status for R&D.[109] Bendetsen, who succeeded Alexander as under secretary in May 1952, also continued to advocate separation. At the end of September 1952, in response to a request from Secretary of Defense Lovett and on the eve of his departure from the under secretary post, Bendetsen wrote a lengthy assessment of the Army's organization, particularly emphasizing the fragmented nature of the service's logistics structure. The result, he wrote Lovett, was that the Army's "research and development operations are not closely related to military problem areas." Moreover, the reorganization put into effect in late

1951 had not corrected this deficiency.[110] Despite this evidence of dissatisfaction, Secretary Pace failed to revisit the issue of research and development organization before his term as secretary ended with the turnover of administrations in 1953.

Project Vista: Scientists and the Defense of Western Europe

In the spring of 1950, Secretary of the Army Gray's special study group had concentrated on the problem of ground defense in Western Europe. Within a year, the prospect of war on the continent seemed much closer to reality. Early in 1951, the Army, together with the Navy and Air Force, contracted with Caltech for a study of land and tactical air warfare to be known as Project Vista (after the project site, the Vista del Arroyo hotel in Pasadena, California). Its objective was to identify tactics, techniques, and equipment, including the use of tactical nuclear weapons that would improve military effectiveness. Although not formally stated in the contract, the project was to focus on ways to halt a Soviet attack launched across a wide front in Europe.[111]

The contract with Caltech was not the first time the services had turned to a major university for help in addressing key defense issues in the postwar period. In 1950, the Navy sponsored an MIT study that brought together a variety of experts to examine undersea warfare (Project Hartwell). Similarly, coincident with the Caltech undertaking, the Air Force initiated and was soon joined by the Army and Navy in supporting an investigation of continental air defense (Project Charles) that would also be organized and directed by MIT.[112] Often called "summer studies" because their university participants were more available during the summer academic recess, such initiatives enabled the services to draw upon expertise not available within their own scientific and technical establishments.[113] But they also reflected structural weaknesses in the Defense Department's organization for research and development that made responding to broad military problem areas difficult. As has been described, the Army's decentralized and fragmented research and development organization was ill-suited for this kind of analysis. So was the Research and Development Board with its disparate collection of committees, organized by specific types or categories of weapons or by individual scientific and technical fields, and all burdened, to one degree or another, by interservice rivalry.

Like MIT in Project Charles, Caltech employed a task-force approach in Vista. Of the approximately 120 participants, 39 were Caltech faculty. Other universities supplied 19; the Cornell Aeronautical Laboratory, 15; government laboratories, 17; and industry and unattached individuals (including some retired military officers), 23. Each military service also assigned a full-time, on-site liaison officer, and a project officer at its Washington, D.C. headquarters. In all, Vista expended approximately 8,500 "man-days" of work, about half of which were supplied by the Caltech faculty.[114]

Many prominent American scientists contributed to Vista. Physicist Lee DuBridge, president of Caltech and a member of the Army's Research Advisory Panel, chaired the project.[115] William A. Fowler, also a Caltech physicist and future Nobel laureate who had worked on rockets and proximity fuzes during World War II, was Vista's scientific director. Other senior Caltech faculty members involved in the project were Clark B. Millikan, who had helped found the Guggenheim Aeronautical Laboratory at Caltech and had chaired the Research and Development Board's Committee on Guided Missiles; and physicist Charles C. Lauritsen, who would be named to the Army's new Scientific Advisory Panel at the end of the year. From the University of Chicago came Willard F. Libby, an expert in radio carbon dating, who would later win a Nobel Prize in chemistry. Both Edward Teller and J. Robert Oppenheimer also participated. Among the military consultants were Lt. Gen. Albert C. Wedemeyer and Maj. Gen. Paul Baade, both retired Army officers.[116]

The participants were divided into 13 groups with futuristic designations that investigated particular aspects of tactical warfare. For example, the "Aeron" group examined tactical air operations, "Fieferon" assessed field force weapons, and "Specon" concentrated on "special" (nuclear) weapons. In addition to providing liaison officers, the services also presented briefings, both at the Vista hotel site and in Washington, and facilitated access to personnel and information throughout the military scientific and technical establishment.[117]

For a while, the Air Force demonstrated considerable enthusiasm for Vista.[118] But Air Force Chief of Staff General Hoyt S. Vandenberg soon became convinced that, in emphasizing tactical nuclear weapons ("take the battle back to the battlefield"), the project represented a threat to strategic air power's preeminent place in national defense. On one level, attaching more importance to such weapons would mean diverting limited resources from the nuclear stockpile, and, in a larger sense, directly challenge the concept of strategic deterrence. Another reason for Air Force hostility to Vista was the study's support for control by ground commanders of aircraft engaged in tactical air support—a management of air assets that was unacceptable to Air Force leaders.[119]

In contrast to the Air Force, the Army embraced Vista wholeheartedly. Soon after the report was submitted to the service secretaries in February 1952, an ad hoc committee from the Army staff, chaired by a general officer, began to evaluate it, asking dozens of Army agencies for comment.[120] Of the 260 Vista recommendations pertaining to the Army, the committee determined that approximately 150 involved more than one military department and thus needed the attention of the Joint Chiefs of Staff, leaving the remainder for the service to address independently.[121]

The Army favorably endorsed many of the proposals in the latter group, particularly those requiring no hard and fast commitment or those consistent with steps the service had already taken. Thus, the Army staff committee readily accepted the suggestion that plans to produce antiaircraft guns in quantity after

1953 "should be carefully reviewed" because "more effective weapons" (i.e., missiles and rockets) would probably be developed.[122] Similarly, there was no objection to Vista's recommendation that the Army continue its high-priority work on a proximity-fuzed antitank mine.[123]

In some instances, the Army staff committee approved a Vista proposal without accepting the rationale behind it. Many of the weapons or other systems that Vista thought should be developed were intended to support its concept that Western European defense should be conducted by specialized defensive forces operating from "strongpoints." Vista asked that Army agencies thoroughly examine the idea. Even though Army organizations had already considered the general proposition, the Army staff committee agreed that it merited further study but maintained at the same time that "the static nature of the Vista concept . . . is unacceptable. The offensive-defensive [offensive operations carried out from a defensive posture to disrupt or defeat an enemy attack] is essential when defending on a wide front."[124]

In other cases, the Army flatly rejected Vista's advice. For example, the staff committee did not concur that the Army should develop a means to stabilize the trajectory of large rockets during burning by using a beam rider, gyro, or inertial control system.[125] Nor did it agree to substitute a shoulder-fired 37-mm. recoilless rifle for the 57-mm. gun then in service.[126]

One Vista recommendation implemented by the Army—establishment of a "combat development group"—had long-term consequences for the service's acquisition process. According to the scientists, the Army needed an organization to apply scientific methods of analysis and experimentation in relating new weapons to existing doctrine or tactics, or conversely, in identifying a requirement for a weapon based on new tactical concepts.[127] When General Collins, the chief of staff, met with DuBridge and other Vista members in February 1952, he affirmed the potential value of such a unit.[128] By the end of the year, the Army had established the Combat Development Group at Army Field Forces headquarters.[129] Collins described the initiative as "the best thing to come out of the Vista Report."[130]

The Army's involvement with Project Vista reflected its qualified attitude not only toward science and technology but also to scientists themselves. The Army's support for the study demonstrated that it was just as interested as the other services in the benefits that science and technology might provide. On the other hand, the Army staff was wary of recommendations that intruded into areas traditionally the exclusive domain of military professionals, such as strategy and doctrine. Vista's concept of a strongpoint defense of Western Europe was not well received because it challenged the primacy of the offensive in Army doctrine. In the opinion of some uniformed officers, scientists were useful when they stuck to technical matters; and dangerous when venturing into fields where they were amateurs.[131]

Whatever the Vista report's ultimate impact on combat effectiveness, Secretary of the Army Pace saw that the study might be useful for another reason: it could be a powerful weapon in the battle with the other services for a larger share of the defense dollar. When Pace received the Army staff committee's review of the Vista study, he commended the staff's comprehensive appraisal, but indicated his disappointment that there seemed to be a lack of awareness of the report's potential. "We have discussed many times," he wrote the chief of staff, "the absolute necessity of getting an abstract and impartial evaluation of the Army's role as an instrument of national security. Here without solicitation we have such an evaluation and yet apparently we have failed to realize it or to move immediately to capitalize on it." Noting that the report of the President's Air Policy Commission in early 1948 had not invented the proposal for a 70-group Air Force but had surely provided stimulus for it (see chap. 6), Pace directed that "an aggressive program" for using the Vista report "to advance the Army's position" be prepared and submitted for his approval "as a matter of highest priority."[132] Following the secretary's instruction, the Army staff declassified portions of the report for public release and downgraded the security classification of others so that they might be presented to congressional committees in executive session in hearings on the FY 1953 budget. But in both cases, the only material made available was that portraying the Army favorably.[133]

Ontos: Civilian Control, Economy, and the Defense of Europe

One of the Vista recommendations the Army staff did not want to highlight concerned Ontos, the antitank weapon then being developed by the Ordnance Corps. The Caltech study urged the Army to freeze the system's design and to "initiate high priority procurement in sufficient numbers to meet the tank threat in Western Europe."[134] Based on contacts with automotive industry representatives, the scientists believed 10,000 could be produced by mid-1952.[135] The Army staff's ad hoc committee did not concur with these suggestions, maintaining that production should not begin until Ontos had been fully field-tested.[136] Aside from the question of its readiness for production, some in the Army, first and foremost General Collins, were hostile to Ontos because of its defensive orientation and potential to threaten the tank's primacy among the service's mechanized weapon systems.[137] Secretary Pace, however, had been an early Ontos supporter. In fact, in October 1951, several months before the Vista group submitted its report, he directed the chief of staff to accelerate Ontos' development.[138] That decision, now reinforced by the scientists' call to move quickly to production, brought the Army's civilian secretary into conflict with its top uniformed officer. The dispute involved not only the issue of the appropriate development pace for Ontos, but also, at least in Collins' mind, the future of the tank and the continued ascendancy of the offensive in the Army's doctrine.

The Army began studying the feasibility of the system that became Ontos in March 1951. In October it awarded a "letter of intent" (letter contract) to develop the vehicle to the Allis-Chalmers Corporation of Milwaukee, Wisconsin, after also considering design proposals submitted by the Ford Motor Company and the General Motors Corporation. According to the contract, Allis-Chalmers was to work under the supervision of the Army's Detroit Arsenal and provide 13 pilot models, but spend no more than $1,218,998. In April 1952, the Army concluded a "definitive" fixed-price contract with Allis-Chalmers for the pilot models to be delivered by October 1952. The revised contract price was $2,448,200.[139]

Pilot Ontos test vehicle mounting six 105-mm. recoilless rifles, 1952. (Note: In 1953, Ontos vehicles were modified to mount six 106-mm. recoilless rifles.)

As it eventually evolved, the system was a relatively lightweight, fully tracked, highly mobile vehicle carrying a crew of two, and armed with six 106-mm. recoilless rifles mounted externally.[140] Ontos was agile but lacked the capability for sustained action on the battlefield. It carried only eight 106-mm. rounds in addition to those in the six outer gun tubes. It was also vulnerable, having to withdraw to cover for protection during reloading.[141] For this reason, Ontos would normally fight from ambush positions.[142] The advanced 106-mm. rifle (called BAT, for battalion antitank weapon) to be carried by Ontos had been in development since 1950 and was intended to be capable of knocking out the Soviets' heaviest tank, the huge JS III (Joseph Stalin III) model. The BAT system employed spotting rounds from a .50-caliber rifle to improve the accuracy of fire from the 106-mm. recoilless rifles. In addition to Ontos, the Ordnance Corps was also designing an ordinary jeep carrier for the BAT.[143]

LETTER OF INTENT/LETTER CONTRACT

A letter of intent or letter contract is a form of contract by which the government authorizes the contractor to begin work and incur costs. Although the terms, specifications, and price of the work are not yet agreed upon, a letter contract is specific enough to show the purpose and scope of the final contract to be executed. Letter contracts await negotiation before they can be "definitized." [I]

Secretary Pace, after two years as the Truman administration's Budget Bureau director, found Ontos particularly attractive because it promised to be much less expensive than the tank. Initial estimates put the unit cost of Ontos at $25,000–$30,000; the M47 medium tank ran approximately $240,000 per copy.[144] In early November 1951, Pace participated in a discussion of the tank's future in combat with several officers from the Army staff, including General J. E. Hull, the vice chief of staff. The secretary told the group that the Army must constantly evaluate the tank's vulnerability with respect to recoilless weapons. He also noted that tanks were increasing in weight at the same time that the availability of raw materials was becoming more of a limiting factor in warfare. (In July, the Office of Defense Mobilization had instituted the Controlled Materials Plan, thus underlining the need for conservation of raw materials.) Stating he hoped that Ontos was being developed "on a crash basis," Pace reminded everyone present that "the public and Congress were constantly hoping for a cheaper, highly effective weapon in the armored field."[145]

By mid-summer 1952, despite Secretary Pace's desire for rapid progress, Ontos development was not far along. Only three pilot models had been manufactured and the system was just entering the engineering test phase, the first step in the Army's formal and lengthy evaluation process for new weapons and other equipment. The most optimistic estimate, assuming successful completion of all tests by January 1953, was that quantity production could start early in calendar year 1954.[146]

In July 1952, General Matthew B. Ridgway, Eisenhower's successor as Supreme Allied Commander, Europe, wrote General Collins asking if testing of Ontos and BAT could be expedited to make them available more quickly, not to U.S. forces, but to NATO allies under the Mutual Defense Assistance Program. He believed the new antitank weapons would be necessary "to withstand the mass of Soviet armor which will inevitably be launched against us at the very outset of hostilities. . . ." If possible, Ridgway wanted procurement orders to be placed before the end of FY 1953.[147]

U.S. ARMY TEST AND EVALUATION SYSTEM

The basic framework of the Army's extensive test and evaluation system had been established between the two world wars. The developing agency (a technical service) conducted "engineering" tests to determine if the new item met scientific and technical standards. It was then turned over to the user (after 1948, the Army Field Forces) for a series of "service" tests that assessed its suitability for field use. Once accepted by the AFF, the equipment could be issued to tactical units. Sometimes, additional "user" or "troop" tests would be required. Normally, each step took place sequentially with developer and user making independent evaluations. During World War II, under pressure to put better weapons and equipment into the field as rapidly as possible, the Army departed from the test and evaluation system by conducting engineering and service tests simultaneously or by overlapping testing and production. The Army generally, but particularly the AFF representing the interests of the user, was reluctant to compress the test and evaluation process, especially to begin production before testing had been completed.[11]

General Collins replied that he could not approve the request. For one thing, he did not think it wise to accept any weapon for the NATO partners until it had been fully tested by the Army Field Forces or to put the system in the hands of foreign forces before it had been issued to U.S. troops. Additionally, short-circuiting the acquisition cycle to initiate early production created problems:

> We have of necessity placed several combat vehicles in production without complete test and evaluation in the past. This has resulted in numerous changes in production and modification to vehicles already produced. While this has speeded our readiness considerably, the procedure has caused production difficulties and added costs. Furthermore, desired modifications are not always practical to incorporate into a vehicle already off the production line.

Thus, while Collins indicated that testing of the two antitank weapons might be hurried up some, he opposed starting production before the full evaluation process had run its course.[148]

At this point Secretary Pace, who was then in Germany and was aware of Collins' letter to Ridgway, intervened. In a terse telegram to the chief of staff on 8 August 1952, Pace declared: "Appreciate your taking no action to implement your letter to Ridgway concerning method of expediting Ontos and BAT. Expect to participate in final decision myself."[149] Pace told Lt. Gen. Maxwell D. Taylor, the deputy chief of staff for operations and administration who was accompanying him in Europe, that he wanted to be briefed on the pros and cons of telescoping the development, testing, and production of Ontos and BAT when he returned to Washington.[150]

The Army staff undertook the analysis Pace had requested and presented it to General Collins for approval before submitting it to the secretary. The staff's view was that engineering tests and service tests could take place simultaneously, but that production should not begin until Ontos and BAT had been accepted by the Army Field Forces. Collins concurred with the recommendations but also remarked that Ontos was "a cheap tank destroyer, not a replacement for the tank. The infantry needs a tank to fight other infantry."[151]

During the briefing for Secretary Pace on 4 September 1952, General Collins emphasized BAT's effectiveness as a tank killer and as one element in the array of the Army's tank-defeating weapons. Significantly, in this context Collins referred to BAT mounted on a jeep carrier, not on Ontos. Although acknowledging that the number of tanks assigned to a division should be reduced, the chief of staff declared that it should not be because of the addition of Ontos. Perhaps to Collins' surprise and relief, Pace conceded that Ontos would not replace the tank. He also did not insist that production be initiated before testing was finished. Nonetheless, Pace reminded all those present just who was in charge by requiring that testing adhere strictly to the projected schedule and be concluded by January 1953 "or that an explanation satisfactory to him be given as to why the time should be extended."[152]

On 9 January 1953, with less than two weeks to go in his term as Army secretary, Pace was briefed on the status of Ontos and BAT. The news was not good. Testing over the previous four months had revealed deficiencies in both that had not yet been corrected. But the problems with BAT were less serious, and General Collins recommended that production begin, even though more tests were needed before the Army Field Forces could accept the system for troop issue. On the other hand, the chief of staff did not advise starting Ontos production until service tests were completed. Even then, he stated, the Army should procure only 300 for field testing with units in Korea and Europe.[153]

Pace expressed disappointment. He said that Ontos "had captured his imagination and the imagination of the chairmen of certain committees in Congress with which he dealt." According to the secretary, the Army staff was being "over-conservative" regarding the antitank system. He believed Ontos would be a great asset in the defense of Europe and emphasized its importance as a low-cost program. Furthermore, enough should be ordered to make production attractive to the manufacturer.[154]

Ontos with Marines at Chu Lai, South Vietnam, June 1965.
Courtesy, Dr. Robert S. Cameron, U.S. Army Training and Doctrine Command, and *Armor*.

In response, General Collins defended the Army's approach to Ontos and strongly reaffirmed the tank's paramount role in combat. The Army, he asserted, was "not opposed to change . . . it accepted new ideas and new equipment as quickly as any other organization." At the same time, since soldiers' lives and taxpayer dollars were in the balance, something new should not be produced or replace a "tried and tested" item unless it were shown to be satisfactory. But even when finally accepted, Collins argued, Ontos could not replace the tank. U.S. Army infantry divisions, he pointed out, "were organized for offensive combat, and . . . for offensive combat the tank was essential. Further, any worthwhile defense was based on the full utilization of the counterattack and for the counterattack the tank was also essential." He also cautioned against stressing Ontos' relatively modest price tag because "economy-minded individuals would obviously find the cost differential between the Ontos and the tank attractive."[155]

Although still urging that Ontos be expedited by "all practical means," Secretary Pace went along with General Collins' insistence that production not overlap service testing. Perhaps the secretary had found the chief of staff's points persuasive, or perhaps, with so little time left in office, he did not want to force a course of action so strongly opposed by the Army Field Forces, the Army staff, and Collins. In any case, as in the previous fall, Pace chose not to override the staff and interfere in the acquisition process. The Vista endorsement and the argument for economy were not powerful enough weapons to use against the uniformed military's professional expertise. What both Pace and Collins lacked was an analytical framework—a way to measure's Ontos' potential effectiveness vis-à-vis the tank in countering a Soviet armored assault in Western Europe. In the end, the Army never bought Ontos. It was procured by the Marine Corps and eventually employed in Vietnam.[156]

PROCUREMENT AND PRODUCTION

From FY 1948 through FY 1950, procurement funds available to the Army amounted to approximately $5 billion.[157] In sharp contrast, during the period of war and rearmament from FY 1951 through FY 1953, the Army received $19.6 billion for procurement, or about 27 percent of the total of $72 billion that Congress appropriated for all military procurement (the latter constituting almost half the military appropriation).[158] Among the major items purchased with the $72 billion and delivered by the end of the Korean War were 11,706 tanks, 104,331 .50-caliber machine guns, and 116,136 two and one-half ton trucks.[159] Army planners had made some preparations for industrial mobilization in the event of war, but those measures proved inadequate for such large-scale production. Deliveries of many key items fell well behind schedule.

Numerous factors accounted for the delays. The Army had little control over some, notably the impact of shortages of machine tools and raw materials.

Other reasons for lagging output were its responsibility. The most important of these was the decision to compress the acquisition process for many weapons and other items of equipment by initiating production before development was completed. The Army called this "telescoping" the programs. Intended to support the war in Korea and to ready the Army for a possible war with the Soviet Union that the National Security Council estimated might occur as early as mid-1952, the acceleration complicated production and resulted in some inadequately tested systems that performed poorly in the field. For the Army, "telescoping" was a matter of necessity, not the approach to acquisition that it favored. For the Air Force, in contrast, overlapping development and production was an essential element in a new acquisition strategy that it would begin implementing before the end of the Korean War (see chap. 5). Eventually, this practice would be known as "concurrency."

Procurement Prior to the Korean War

The $5 billion appropriated for Army procurement in FYs 1948–1950 was about one-third of the Army's total budget of $14.8 billion for those three years.[160] Not all of this money was for Army requirements. In FY 1949, about one-fourth of the $2 billion for procurement purchased materiel for other government agencies.[161] Most of the remainder went to buy food, clothing, and other basic supplies. Only a fraction of the procurement dollar bought major items of equipment such as tanks, antiaircraft guns, radar fire control systems, trucks, or ammunition. The Army spent but $57 million on those items in FY 1948. The amounts for new equipment rose significantly the next two years—to $302 million in FY 1949 and $288 million in FY 1950—but still did not put much of a dent in the Army's needs.[162]

Before the Korean War, most of the weapons and equipment for the 10-division Army came from its World War II stocks. This inventory, however, was unbalanced. There were plenty of machine guns and towed artillery pieces but severe shortages of self-propelled artillery, antiaircraft guns, and radio equipment.[163] Furthermore, much of the materiel was unserviceable and required major overhaul before it could be used.[164] Lieutenant General Aurand, director of the Service, Supply, and Procurement Division on the Army staff, told Secretary of Defense Forrestal in September 1948 that of the 15,526 tanks the Army had on hand, only 1,762 were ready for issue to field units.[165] Additionally, with each passing year, World War II materiel grew older and more out-of-date.

What little procurement of major items the Army was able to undertake before the Korean War largely reflected the need to fill gaps in its World War II stocks and to acquire some advanced systems to support the missions it had been assigned. In FY 1948, the Army spread the $57 million it spent on major equipment among a variety of items; the largest single expenditure was $8.9 million for ammunition.[166] The next year, the Army was able to begin a modest modernization program. For the first time since 1944, the Ordnance Department purchased trucks in quantity.[167] In keeping with its air defense responsibilities, the Army also spent nearly $40 million of the $302 million available for major equipment to begin procurement of two newly developed antiaircraft systems.[168] The T33 radar fire control system directed 90-mm. and 120-mm. antiaircraft guns against high-altitude targets; the 75-mm. antiaircraft gun (Skysweeper) with an on-carriage radar and computer covered lower altitudes.[169] Spending on the T33 and Skysweeper increased in FY 1950 to $115 million, about 40 percent of the $288 million allocated for major equipment purchases.[170]

M46 Pattons, 64th Tank Battalion, Korea, 1951.
Courtesy, Dr. Robert S. Cameron, U.S. Army Training and Doctrine Command, and *Armor*.

Improving the tank force was also part of the limited modernization that began in FY 1949 and continued into FY 1950. In all, $130 million of the $590 million spent on major new equipment went to tank procurement.[171] New light, medium, and heavy tanks were being designed before the Korean War, but limited funding prevented quantity procurement. To meet the need for a more capable but relatively less costly medium tank, the Army chose to upgrade its most advanced World War II model, the M26 Pershing, designating the converted vehicle, the M46 Patton. Taking advantage of the development work that had been done on subsystems, the Ordnance Department installed a new 810 horsepower air-cooled engine (replacing the M26's 500 horsepower liquid-cooled power plant), and a new cross-drive transmission that simplified steering and reduced driver fatigue. In FY 1950, in addition to the M26 conversion, the Army began procurement of a new light tank, the M41 (named the Walker Bulldog following Lt. Gen. Walton H. Walker's death in Korea in December 1950) to replace its World War II M24 Chaffee light tank.[172]

U.S. ARMY TANK CLASSIFICATIONS AND ROLES

On the eve of the Korean War, the U.S. Army classified a tank as light, medium, or heavy, not by the size of its main gun but by its weight and operational role. A light tank weighed less than 26 tons, a medium tank between 26 and 55 tons, and a heavy tank, 56–85 tons. In the U.S. Army, the light tank's roles were primarily reconnaissance and security. The medium tank was the principal tank in both the armored and infantry division. Its roles were assault, pursuit, exploitation, and antitank operations. It also supported light tanks conducting reconnaissance. According to the Department of the Army Armored Panel report of June 1950, the heavy tank would be used for assault, and to support medium tanks in attack and defense. The heavy tank should be "a weapon of such powerful capabilities that it may be the master of the battlefield."[III]

The modernization under way by the spring of 1950 would improve readiness, but would still be far short of what the Army considered essential for carrying out its responsibilities. One Army staff analysis noted that in FY 1950 the Army was devoting about 7 percent of its budget to the purchase of major equipment items; in contrast the Navy had allocated 21 percent and the Air Force 43 percent for the same purpose. To be able to defend the United States against air attack and to cooperate with NATO allies in preventing Soviet forces from overrunning Western Europe, according to the staff paper, the Army "must place increased budgetary emphasis on equipment readiness even at the expense of manpower."[173] For the already under-strength, 10-division Army of 1950, stretched thin by global commitments, reducing manpower in favor of modernization was a draconian choice. The consequences would not only have been an even smaller force but also, until more advanced weapons could be fielded to counter the adversary's advantage in numbers, a more vulnerable one.

The North Korean attack, with the boost it gave to military budgets, made so unpalatable an alternative unnecessary. Still, even with the ample funds being appropriated by Congress, it would take time for industry to produce the weapons and equipment the Army needed. In October 1950, Maj. Gen. William Reeder, deputy assistant chief of staff for logistics (G–4), gave Deputy Secretary of Defense Lovett a pessimistic assessment of how soon new materiel might be expected. He pointed out that only then were the first deliveries of trucks and improved radio equipment purchased with FY 1949 funds being received; none of the 75-mm. Skysweeper antiaircraft systems ordered at the same time had been delivered. "The result of our springing into a modernization program rather than slowly edging into it," Reeder explained, "throws a great demand upon industry, and the inevitable time required for tooling prevents early delivery of equipment. . . . There is therefore the alarming fact that no amount of money poured out in this fiscal year will equip the active Army with modern equipment before the end of FY 1952."[174] Nonetheless, in December 1950, President Truman approved expansion of the Army to 17 divisions by July 1951 (to 18 by mid-1952) and the department undertook to modernize its forces.[175]

Rearmament: Procurement and Production Problems

Despite the influx of funds, the Army buildup was extremely slow. Of a total of 793 items in series production by the end of 1951, just over half had achieved 80 percent or more of planned delivery schedules; nearly 100 had met less than 10 percent of their timetables.[176] Six months later, only 910 of 18,665 medium tanks scheduled had been delivered; and only 364 of 3,614 light tanks. At that time, truck production was somewhat better off—almost 20 percent of the 142,499 programmed had been manufactured.[177]

Numerous factors accounted for the production delays. Some involved the financing and administration of the procurement program; others pertained to the manufacturing process. Some stemmed from choices made by the Army or from weaknesses in its acquisition process; others, more or less beyond the Army's influence such as machine tool or raw materials shortages, were partly a consequence of the Truman administration's decision to pursue large-scale rearmament while affecting the domestic economy as little as possible.

Some Army officials believed that the government's "guns and butter" approach to war and rearmament undermined production of military materiel. In August 1951, Under Secretary of the Army Alexander wrote Deputy Secretary of Defense Lovett that the "lack of a sense of national urgency" made dealing with industry more difficult, particularly when it came to closing contracts "under the relatively hard terms required both by law and custom in Army procurement."[178]

From the Army's perspective, funding uncertainties were another important reason for production delays. OSD guidelines for preparing the FY 1952 budget, for example, did not permit including estimates of both the costs of modernization and of combat in Korea. This restriction affected all the services, but it fell most heavily on the Army. In the summer of 1952, Lieutenant General Larkin, the assistant chief of staff for logistics, explained to General Collins that because of unfunded Korean operations, "it became necessary to reprogram and to secure OSD approval of [revised] programs and schedules. This consumed a considerable portion of the first half of FY 1952. Consequently, only a little over six months of FY 1952 was left for placing of contracts which in turn delayed production." Moreover, funds for some categories of materiel could not be obligated until Congress passed the annual Defense Department appropriation. Normally, Congress acted before the end of the fiscal year, but the FY 1952 budget was not approved until mid-October 1951, more than three months late.[179]

The Army also complained that the Department of Justice, wary of charges of monopoly and restraint of trade, was slow to approve its request to form industry integration committees authorized by the Defense Production Act of 1950. Used successfully during World War II to expedite production, the committees included representatives from the Army and the companies engaged in manufacturing a particular item. The committees were ideally suited for exchanging information and for coordinating numerous production activities, especially facilitating changes in design and ensuring that parts were uniform and interchangeable. By the end of July 1951, the Justice Department had agreed to only 2 committees (light tanks and ordnance range finders for tanks) of the 24 asked for by the Army.[180]

Some causes of lagging production were internal to the service. In FY 1952, the Army employed about 25,000 civilians to administer a huge procurement program involving some 565,000 contracts and purchase orders initiated that year alone.[181] Still, there were not enough qualified people to do the job.[182] In November 1951, G–4 reported: "Field procuring agencies required considerable expansion and reorganization and the experience was of necessity spread thinly. This, coupled with increased workload, served to delay obligations."[183] The Army also had difficulty attracting high-quality personnel to work in procurement, attributing some of the problem to the field's low prestige and deficiencies in the Civil Service system.[184] To meet the need for trained contracting officials, the Army tripled the capacity of the procurement course it had established in January 1950 at the Quartermaster School at Fort Lee, Virginia. By the end of 1953, 1,100 military and civilian students had graduated from the course.[185]

Another major internal weakness delaying industrial output was the Army's initial inability to estimate accurately the quantities of materiel it required or to draw up realistic delivery schedules. This deficiency made it difficult for the Defense Production Administration to allocate raw materials, placed inordinate pressure on the already heavily stressed machine tool industry, and created production peaks and valleys as programs were revised. During the war, several outside analysts heavily criticized the Army's process for generating quantitative requirements, especially the lack of Army staff (G–4) review of estimates prepared by the technical services. In the study it conducted for the secretary of the Army in the summer of 1951, Harvard's Graduate School of Business Administration placed poor requirements estimates in the larger context of the Army's failure to establish a system linking strategic plans, force programs, and its budget. The report's authors showed less concern that requirements might be exaggerated than that they might be understated: "We are convinced that the Army's administrative machinery for planning, for requirements generation, and for budgeting . . . is now dangerously out of control, that the Army does not know what risks it has accepted, and that the full requirements of the Army are seriously compromised."[186]

Army officials conceded that its requirements estimates and production schedules were unrealistic. In July 1951, appearing before a House subcommittee investigating federal supply management, Under Secretary Alexander admitted: "Undoubtedly mistakes have been made. Requirements may have been overstated or the need for immediacy exaggerated."[187] By the time Alexander testified, OSD, as described in chapter 3, had begun to require Munitions Board review of the services' production schedules. At the end of November, Alexander was able to inform Secretary of Defense Lovett that, according to comments received by Defense Production Administration officials, "our requirements computations are much improved."[188]

With respect to the broader question of integrated planning, programming, and budgeting, the Army made little progress during the war. Although in April 1950 it initiated a new process ("Army Program System") to better connect requirements and resources, the service's inability to include projected costs of Korean operations in its annual budget submission held back development of the new framework.[189]

Along with difficulties related to formulating, financing, and administering the procurement program, production slipped in 1951 because industry, operating within the context of a dual economy, did not have sufficient machine tools, raw materials, and facilities to manufacture large quantities of military end items. Machine tools were at the top of the list of shortages. According to the Ordnance Corps, they were the "most critical bottleneck" in its FY 1951 and FY 1952 procurement programs.[190] Production also faltered because industry could not initially obtain enough raw materials. Although some metals such as nickel and tungsten would remain scarce, the Army believed most shortfalls were a result of a poorly functioning allocation system. The establishment of the Controlled Materials Plan in July 1951 and the military's agreement to identify production priorities early in 1952 eased pressure on both raw materials and machine tools.[191] In addition to raw materials and tooling, industrial plant was in short supply when rearmament began. By the end of FY 1952, the Army had spent more than $1.5 billion reactivating, converting, or expanding 67 government-owned and 211 privately owned facilities.[192]

Tank production clearly reflected the lack of machine tools, inadequate raw material supplies, and insufficient industrial plant. In July 1951, G–4 informed Secretary Pace that due to shortages in these areas, it appeared that only two tank manufacturers would be operating by January 1952 instead of the five originally planned, forcing the Chief of Ordnance to recommend tank delivery schedules be delayed by six months. Such problems, stated G–4, were typical of the Army's production program as a whole.[193]

Changes in product design, initiated after manufacture had already begun, were another major factor in production delays. The Army believed modifications to be necessary for several reasons. One was to ensure that soldiers continually received the most technologically advanced equipment. In April 1952, the Army acknowledged to Carl Vinson (D-Ga.), chairman of the House Committee on Armed Services, that schedules were behind, in part, because of "the increasing importance of incorporating the products of research as they develop, rather than taking the simpler route of freezing production designs for weapons which are then easily produced in mass, only to become obsolescent in the warehouses." In addition to providing the most capable systems, design changes sometimes were necessary in order to substitute a readily available raw material for one in limited supply.[194]

Perhaps the chief cause of design changes, however, was the Army's decision, made in the crisis atmosphere of the second half of 1950, to overlap—"telescope"—the development and production of many of its major systems. Under this acquisition strategy, testing and manufacture took place concurrently, often resulting in production slowdowns as deficiencies revealed by testing were corrected. Additionally, problems that might have appeared during a normal, sequential acquisition cycle, when testing was more extensive, sometimes showed up only after the system had been fielded. Looking back near the end of the Korean War, Lt. Gen. Williston B. Palmer, who succeeded Larkin as assistant chief of staff for logistics in December 1952, thought the telescoping decision to have been worthwhile. He told Robert T. Stevens, Army secretary in the new Eisenhower administration, that it "quite naturally entailed a certain amount of risk, but subsequent events have proved the wisdom behind the decision and we are now a year or better ahead of ourselves [than] had we followed the normal research-development-production cycle."[195] However, concurrency's record in the Army's tank program suggests that Palmer's rosy view may not have been justified.

Telescoping Development and Production: The Tank Program

Within a year of the start of the Korean War, the Army placed into production more than 300 items of materiel still in the development stage.[196] The large number testified not only to the perceived urgency of the situation but also to the breadth of the Army's research and development program. But the acceleration was only in part intended to support operations in Korea. Only a few of the major new systems—the 3.5-inch rocket launcher (just entering production when the war began) and helicopters—were used there.[197] Others, such as the T33 fire control system for the 90-mm. and 120-mm. antiaircraft guns, played no role in the conflict. Still others, especially the most advanced tank models, would not be ready in time. In the decision to speed up the acquisition process, the need to modernize Army forces sufficiently and in time to meet the growing threat from the Soviet Union weighed more heavily than Korea. Although the buildup achieved gains in readiness, the compression of normal acquisition procedures, as reflected in the tank program, created many problems.

On 25 June 1950, modernization of the Army's tanks was proceeding slowly, deliberately, and on a modest scale. Four hundred M26 Pershings (of 800 funded) had been converted to the improved M46 Patton. The new light tank, T41, was in the early stages of procurement; 4 prototypes had been received and were being tested, but production of a planned 309 tanks was not scheduled to begin for more than a year. Designs existed for entirely new medium and heavy tanks, the T42 and T43, respectively, and prototypes ordered, but none had been delivered. Even had funds been available to produce either tank, almost two years would be required to develop preliminary tooling and to establish production lines.[198] (During development, Army tanks were designated with a "T" and with an "M" when approved for issue to troops.)

In any case, the limited improvements under way in the spring of 1950 probably would not have much affected the imbalance in armored forces between the United States and the Soviet Union. In June 1950, the Army's Armored Panel claimed that the Army and Marine Corps together had only 4,752 "battleworthy" tanks, all in the light and medium classes, to oppose an estimated 40,650 medium and heavy tanks possessed by the Soviets. Moreover, asserted the panel, their tanks were "superior to any we now have." At least with respect to the number of tanks, however, the panel painted a distorted picture. It failed to note that actually the United States had 18,876 tanks of all types in various states of repair, even though only about one-fourth were considered to be "battleworthy." Nor did the panel make a similar assessment of the Soviet inventory, although its report listed over 24,100 of the total of 40,650 Soviet tanks as being in the "Reserves." Nonetheless, the discrepancy in Soviet and U.S. tank forces was significant.[199]

The outbreak of fighting in Korea provided the spur needed to accelerate the Army's tank program. On 12 July 1950, the Army Field Forces asked the Army staff to put tank procurement on a "crash" basis. Among the specific requests were construction of additional M46s; release of the T41 for manufacture; and holding off on initiating T42 production until satisfactory completion of both engineering and user tests, but procuring additional M46 hulls capable of mounting the improved T42 turret (eventually this hybrid became the M47, Patton II). Lieutenant General Ridgway, then the deputy chief of staff for administration on the Army staff, approved all of the initiatives except one. He deferred for consideration by the chief of staff the recommendation that 400 heavy tanks be procured as soon as possible.[200]

Left to right: T43 (M103), M48, M47, and M41 at Aberdeen Proving Ground, Maryland, September 1953. Courtesy, Dr. Robert S. Cameron, U.S. Army Training and Doctrine Command, and *Armor*.

M41 Walker Bulldogs on assembly line.
Courtesy, Dr. Robert S. Cameron, U.S. Army Training and Doctrine Command, and *Armor*.

General Ridgway's actions were the initial steps in a dramatic expansion of tank production. By July 1953, more than 23,000 tanks had been funded and more than 12,000 manufactured.[201] In addition to the M46, the Army brought out four new tank models: the light M41 Walker Bulldog, the medium M47 Patton II, the medium M48 Patton III, and the heavy T43 (eventually designated the M103). However, the telescoped development/production cycle for the new tanks resulted in numerous modifications during the course of and after manufacture.

Ordered directly into production in August 1950 before the prototype had been fully tested, the 25-ton M41 mounted a 76-mm. gun, had a 35 mph cruising speed, and a range of 75 miles before refueling was required. Production began in April 1951 at the government-owned Cleveland Tank Plant that was operated by the Cadillac Motor Company Division of the General Motors Corporation, the tank's contractor, which delivered the first eight M41s in July 1951.[202]

In this period a tank did not stand alone, but was associated with a "family" of supporting vehicles. In addition to the light tank, the M41 family comprised a twin 40-mm., self-propelled antiaircraft gun; 105-mm. and 155-mm. field artillery pieces; an armored personnel carrier; and a cargo tractor. Under this concept the Ordnance Corps sought to use the same chassis, engine, tracks, and other components in as many family members as possible. In January 1951, representatives of the Army Field Forces, G–3 and G–4 on the Army staff, and the Ordnance Corps agreed to release for production the other vehicles in the light tank family "with the full knowledge that in so doing there were certain inherent risks involved by foregoing complete tests and evaluation."[203] In other words, deficiencies that appeared in one system might have to be corrected in the others. By mid-1953, the Army Field Forces had accepted only the M41 and the armored personnel carrier for troop issue.[204]

In September 1950, shortly after the M41 production go-ahead, the Army accelerated procurement of the M47 Patton II. It weighed 49 tons, carried a 90-mm. main gun, had a top speed of 37 mph, and a range of 80 miles. The M47 was a hybrid, basically a combination of the M46 chassis but with the turret and gun designed for the T42. The Army settled on the M47 as the best option for obtaining a better medium tank in the least time. (The T42 continued in development, but was never produced.) Telescoping acquisition of the M47 was especially risky because, unlike the M41, no prototype or pilot model would be manufactured for testing before mass production began. In May 1951, production started at the Army's Detroit Arsenal; the first 10 tanks were delivered by July. From then on, testing and manufacture occurred simultaneously. In addition to the Detroit Arsenal, the M47 was later produced at several other locations by the Chrysler Corporation (the principal contractor), the American Locomotive Company, GMC's Fisher Body Division, and the Ford Motor Company. After undergoing numerous modifications during production, the Army Field Forces finally accepted the M47, and troop issue began in late spring 1952.[205]

THE DETROIT ARSENAL

In May 1940, German armies, spearheaded by tank formations, smashed their way through Holland, Belgium, Luxembourg, and France. The power and speed of mechanized warfare, demonstrated by the Nazi blitzkrieg, prompted the War Department to revamp its tank production plans. But William S. Knudsen, who had taken a leave of absence as president of General Motors to help mobilize the country for war as a member of the National Defense Advisory Commission, recognized that existing tank manufacturing facilities and custom-made techniques would be inadequate. He sought to involve the automobile industry and its mass production, assembly line methods. On 7 June, Knudsen called K. T. Keller, president of the Chrysler Corporation, asking if he would be willing to build and operate a tank plant for the government. The Detroit automaker agreed.

In September 1940, Chrysler, contracting to build the plant at cost with profits coming from tank production, began construction on 100 acres of farmland near Warren, Michigan, about 12 miles north of downtown Detroit, even before the design of the new tank to be manufactured was finished. The one-story, steel-framed structure was huge—five city blocks in length and two in width, a total of 1.1 million square feet. Initially called the Detroit Ordnance Plant, but soon renamed the Detroit Tank

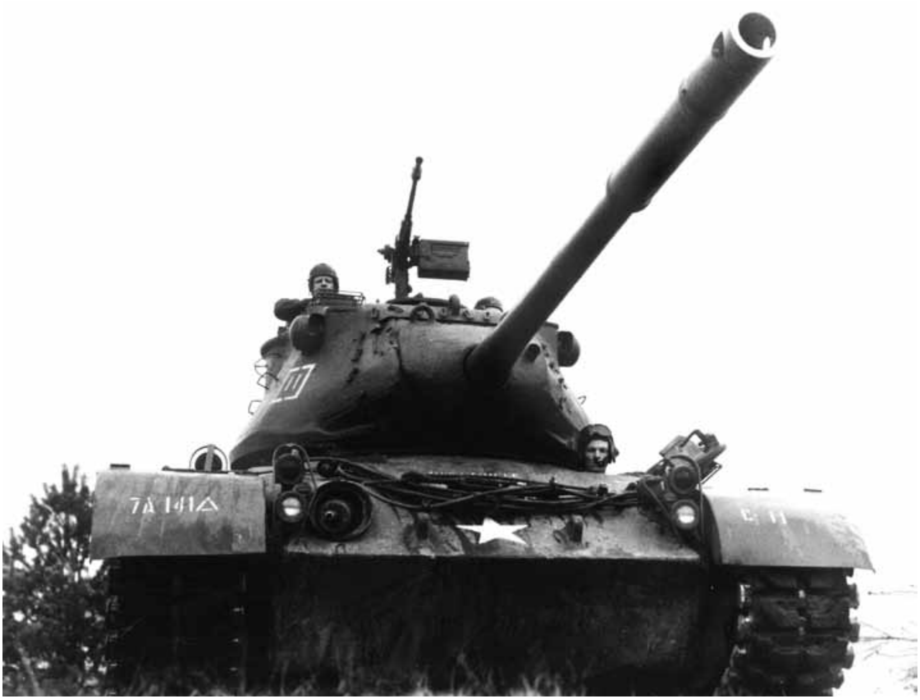
Arsenal, the facility turned over the first tank, an M3 General Lee (M3 General Grant, in its modified version), to the Army in April 1941, just 13 months after Knudsen had contacted Keller.

From 1941 through the end of World War II, the arsenal manufactured 22,234 tanks (mostly M4 Shermans), an output that constituted over one-fourth of U.S. wartime tank production. In December 1942, alone, the plant turned out 896 tanks. The arsenal's unionized workforce numbered 5,389 at its peak in 1942. In a reflection of the social changes brought about by the war, in 1944 almost 25 percent of the plant's employees were women and 10 percent black, half of those women as well.

During the war, the arsenal had been a so-called GOCO (government-owned, contractor-operated) facility. In October 1945, the Army cancelled Chrysler's contract and took over the complex, which now became a GOGO (government-owned, government-operated), called simply the Detroit Arsenal. Until the start of the Korean War, the arsenal built or modified very few tanks and conducted only limited research in its laboratories; it was used largely to store surplus World War II equipment and to manufacture spare parts.

When the Korean War broke out, the Army accelerated several of its tank programs, entering them into quantity production before development was complete. In May 1951, it began to manufacture the M47 Patton II at the Detroit Arsenal, skipping the prototype stage. But, by the spring of 1952, the M47 program was in trouble, some problems caused by "telescoping" the system's acquisition and others attributed to management inefficiency. In July, the Army turned operation of the tank plant over to Chrysler but continued to manage the complex's other activities, including its laboratories. The arsenal was now an unusual combination of GOGO and GOCO.

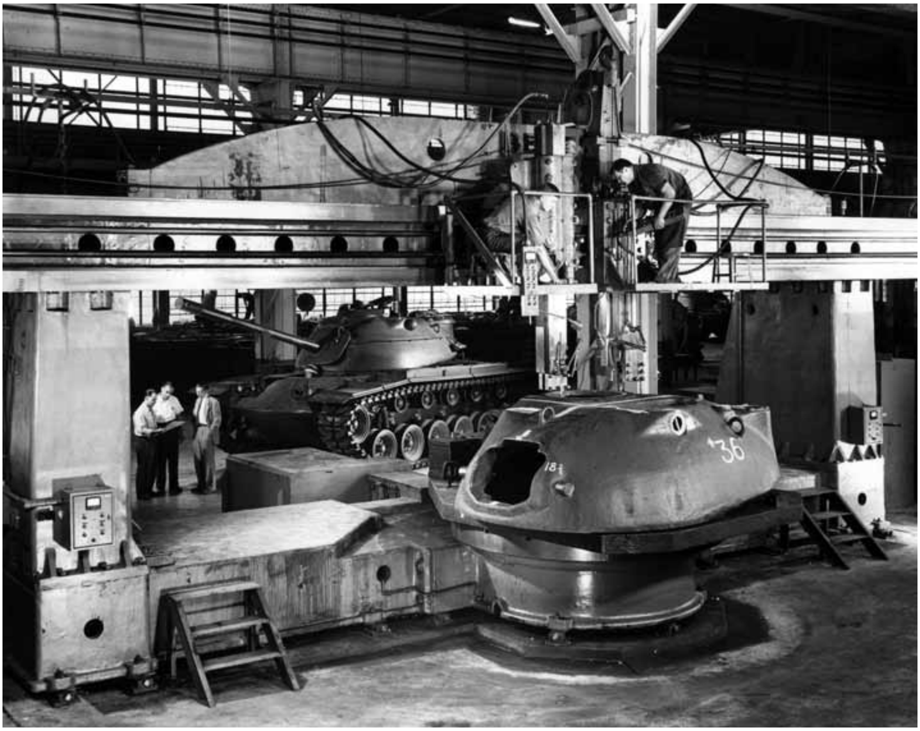
In the decades following the Korean War, the arsenal's tank plant, operated by Chrysler and then by General Dynamics (which acquired Chrysler's Defense Division in 1982), manufactured M60 Patton (the fourth in that series) and M1 Abrams tanks. When it closed in 1996, the plant had produced or modified over 60,000 tanks in its 55-year history. The Army transferred the facility and some adjoining property over to the city of Warren. In subsequent years, the remainder of the arsenal complex would house the headquarters of the U.S. Army TACOM [tank and automotive] Life Cycle Management Command and the U.S. Army Tank Automotive Research, Development, and Engineering Center. [IV]



M47 Patton II, 141st Tank Battalion, Germany, 1954.
Courtesy, Dr. Robert S. Cameron, U.S. Army Training and Doctrine Command, and *Armor*.

Although approximately 6,500 M47s, more than any other U.S. tank, were manufactured before the end of the Korean War, the M47 was a stopgap for a more advanced medium tank, the M48 Patton III, that had begun development in December 1950, also under a contract with Chrysler. Like the Patton II, the Patton III weighed 49 tons, had roughly comparable speed and range, mounted a 90-mm. main gun, and possessed an 810 horsepower engine and cross-drive transmission. Unlike the earlier model, the M48 had a dome-shaped turret affixed nearly flush with the hull, making the tank less vulnerable to enemy fire. It also had wider tracks, a wider turret ring, and a mechanism that allowed rapid replacement of the 90-mm. gun tube.[206]

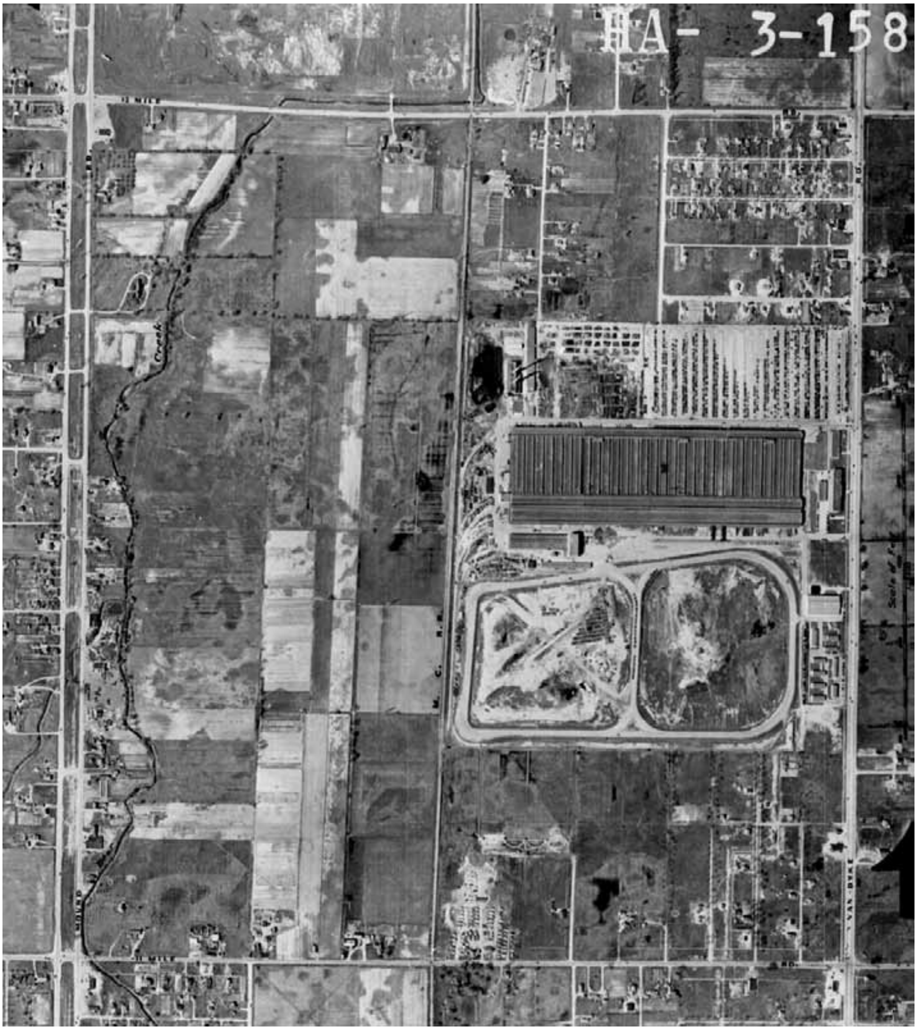
The M48's most advanced feature was a fire control system consisting of a stereoscopic range finder, mechanical ballistic computer, ballistic drive, and periscope for the gunner. Well aware of Soviet numerical superiority after World War II, the Army had stressed improvements in range and accuracy in order to engage opposing armor sooner.[207] Analysis of tank engagements occurring during the war indicated that the side firing the first shot would have a 70 percent probability of success.[208] Although some other U.S. tanks had a stereoscopic range finder, the M48's mechanical computer accounted for ballistic influences imparted by vehicle cant and different types of ammunition and, linked to the drive, automatically elevated the gun.[209]



M48 Patton IIIs being assembled at Chrysler's Delaware Tank Plant, Newark, Delaware. Courtesy, Chrysler Corporation.

As with the M41 and M47, M48 production overlapped development. By December 1951, one year after being awarded the contract, Chrysler had constructed the first M48 pilot. Mass production started in April 1952, concurrent with testing conducted by the Army Field Forces. Early in 1953, G–4 informed Lieutenant General Taylor, the deputy chief of staff for operations and administration, that "[e]fforts are being made to put modifications into production to correct deficiencies noted as soon as possible." By mid-1953, 2,294 M48s had been manufactured, but the Patton III, still undergoing testing and design changes, had not yet been approved for issue to overseas units.[210]

The Army also accelerated acquisition of the M103 heavy tank, but the pace was more deliberate than that for the light and medium tanks; service tests of pilot models would be completed prior to a decision being made on quantity production. Mounting a 120-mm. main gun, the M103 was expected to contend favorably with heavy Soviet tanks, the Joseph Stalin III and its follow-on, the T10. Chrysler contracted to build 300 M103s, but only 80 were for the Army, with the Marine Corps purchasing the balance. By the end of the Korean War, 85 had been manufactured, but the Army had not yet approved the heavy tank for standard issue.[211]



Aerial view of Detroit Arsenal, Warren, Michigan, September 1951. Tank plant is center right.
Courtesy, U.S. Army TACOM Life Cycle Management Command.

Overlapping tank development and production resulted in an almost continuous modification process. In June 1953, the Army told Sen. Homer Ferguson (R-Mich.), chairman of the Subcommittee on Armed Services of the Senate Committee on Appropriations, that of 12,251 tanks delivered since July 1950, 4,926 had been or would be modified before issue.[212] By July 1952, more than 4,000 engineering design changes had been requested on the M41 alone.[213] Of the 2,294 M41s delivered by July 1953, 1,631 awaited modification at the Ordnance Corps depot in Lima, Ohio, or at the Cadillac plant in Cleveland.[214] Because the need to correct deficiencies delayed approval for issue of the M41 to regular units until December 1952, only 20 were in the hands of troops in Europe on 1 April 1953.[215]

The M47 was also plagued with deficiencies that had to be corrected during production or following deployment. Problems with its unproven turret control mechanism, for example, delayed production for months.[216] Other difficulties surfaced after the tank was deployed to Army units in Europe. During 2nd Armored Division maneuvers lasting two weeks in the fall of 1953, 89 (32 percent) of the division's 274 M47s experienced drive failures. Moreover, an inspection after the exercises revealed that another 109 drives (40 percent) could be expected to fail soon.[217] Early in November, Lieutenant General McAuliffe, the Seventh Army commander, wrote General Ridgway, the new Army chief of staff: "This tank was rushed into production with what I consider inadequate service tests. I think the lesson is clear that, for such a complicated mechanism, thorough testing must always take place before the initiation of quantity production. . . . I am very concerned about the repercussions which appear bound to follow when issue of this tank is made to our allies."[218] In his reply, General Ridgway told McAuliffe that corrective measures were under way and that the drive weakness "stems from an original design so marginal that ordinary manufacturing methods do not produce parts meeting required specifications."[219]

By the summer of 1952, many in the Army had become convinced that compressing acquisition, although perhaps justified as an emergency measure to improve readiness, had so many negative consequences it must be avoided in the future. In July, the Army Field Forces complained that slow processing of engineering change orders was delaying approval of equipment for troop issue. In response, the Ordnance Corps asserted to G–4 that the real problem was overlapping what ought to be sequential steps in the development/production process. Releasing equipment for large-scale manufacture that was still under development, claimed Ordnance, resulted in time lost, higher costs, and "a serious dispersion of technical effort in an attempt to retrieve the difficulties resulting from the telescoping in the first place." Although conceding that a better system for expediting engineering change orders might help, Ordnance commented sarcastically that "the only real solution is to judiciously reduce the number of items being 'crashed' since 'crash' handling of developments is far more literal than figurative."[220] In August, one of the arguments presented against going ahead with Ontos production before testing had been completed was that "no satisfactory telescoping of development, test, and production of any armored vehicle has been accomplished to date."[221] That summer as well, the Army Field Forces had become so disillusioned with the M41 that it recommended the Army terminate its production as soon as possible and push ahead with acquiring a new light tank. The Army staff and General Collins agreed but wanted purchase orders then in effect for the M41 to be filled, and insisted that production of the new tank not begin before development was completed.[222]

As long as enough money was available, many of the rough edges associated with telescoping development and production could be smoothed out. The larger problem for the Army was determining a procurement strategy to follow as funding levels declined after FY 1952.

Before the war, the Army had possessed advanced tank designs but lacked money to develop, let alone produce, completely new models. For this reason, it concentrated on subsystems such as the 810 horsepower air-cooled engine, cross-drive transmission, and turret and fire control systems. But these and other subsystems had not been service-tested extensively or at all when installed in new tanks coming off assembly lines after July 1950. Consequently, numerous modifications had to be made that slowed production and delayed fielding.

To avoid similar problems in the future while also seeking to ensure that advanced technologies would continue to be introduced into the Army's tanks, some officers proposed a new approach. They suggested that the M48, for example, then currently in production and expected to be the Army's standard medium tank for several years, undergo "product improvement" (programmed incremental changes) until a more advanced system was fielded. At the same time, acquisition of the M48's replacement would proceed according to the traditional sequential development, testing, and production process. For this approach to succeed, however, at least one M48 production line must stay in operation.[223] Pioneered in the M48 program, "product improvement" was applied by the Army to some of its systems during the remainder of the 1950s.[224] In later decades, this product improvement strategy would be known to the defense acquisition community as "Preplanned Product Improvement."

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Following World War II, Army leaders, like their counterparts in the Navy and Air Force, were convinced that successful application of science and technology would likely determine the victor on future battlefields. Although funds were limited, the Army's technical services established vigorous and varied research and development programs before the Korean War. Their very diversity, however, reflected a fundamental weakness of Army research and development before Korea—it was diffuse. It lacked the firm central direction and clear-cut determination of priorities from the Army staff that might have provided an integrated perspective and sharper focus. At best, the Army staff served as coordinator for the separate technical service programs. As a result, Army research and development did not adjust quickly to changes in the service's missions, especially its rapidly expanding role in Western European defense.

Many Army leaders, especially some of the service's highest-ranking civilian officials, believed that to make research and development more effective, significant organizational change, as well as increased funds, would be required. But those who believed that research and development would be strengthened by separating its management from G–4 encountered opposition from those who believed that policy responsibility for all aspects of logistics should be retained in that staff element. With nearly all of the top uniformed officers in the latter camp, no real change followed from the compromise reorganization implemented in early 1952. Since R&D funding tripled during the Korean War, however, most needs could be met and the Army was able to put off addressing the organizational issue.

Ample funding also papered over weaknesses in the Army's prewar acquisition strategy. With little money available to field new systems before the Korean War, the Army improved subsystems and developed a few prototypes. But much of this advanced technology had not been thoroughly field tested. After accelerated acquisition began, deficiencies appeared that required correction, and production was delayed. Several factors, however, softened the impact of these slowdowns. First, there was enough money to fix the problems. Second, the most advanced systems were not needed in Korea. Finally, the third world war that many American leaders believed imminent in the fall of 1950—a conviction that provided much of the impetus for the military buildup—did not occur. Clearly, however, the Army had been caught short and would have to fashion a more reliable acquisition strategy for the future.

Endnotes

1. Encls to memo, Col. C. Rodney Smith, Chief, Plans and Programs Branch, Office, Under Secretary of the Army, for Secretary of the General Staff, 6 June 1950, sub: Drafts of Remarks for the Army Readiness for Emergency Mobilization Presentation, Army Commanders' Conference, folder Army Commanders' Conf., box 29, entry 24 (Records, Office of the Under Secretary of the Army, Top Secret General Correspondence, 1947–1953), RG 335 (Records of the Office of the Secretary of the Army), Archives II.
2. Doris M. Condit, *The Test of War, 1950–1953*, 227.
3. For the procurement figures, see the tables in Condit, *Test of War*, 241, 259, and 284; for the R&D figures, see the tables in Condit, and the table (Research and Development Amounts Requested of Congress and Amounts Appropriated), 9 June 1953, atch to memo, W. H. Mautz, Director, Economic and Security Estimates Division, OSD, for Gordon Nease, Senate Appropriations Committee, 11 June 1953, sub: Budget Requests and Appropriations for Research and Development, folder Revised FY 1954 Budget, box 7, Budget Files, FY 1954, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO.
4. Dwight D. Eisenhower, *Final Report of the Chief of Staff United States Army to the Secretary of the Army*, 7 February 1948, 5.
5. William W. Epley, *America's First Cold War Army, 1945–1950*, 4, 7; table 8 (Total Army Department Strength, by Month and Major Force, July 1940 through December 1947), in National Military Establishment, *Annual Report of the Secretary of the Army*, 1948, 296.
6. Table 4 (Forces in Being, 1950–1952), in Walter S. Poole, *The Joint Chiefs of Staff and National Policy, 1950–1952*, 71. At this time, an infantry division comprised three regiments, each normally with three battalions. In an under-strength division, each regiment had only two of its normal three-battalion complement.
7. Table 7 (Congressional Action on FY 1951 Military Budget), in Steven L. Rearden, *The*

Formative Years, 1947–1950, 380.
8. Table 6 (Actual Personnel Strengths of U.S. Armed Forces: 1952–1956), and table 8 (Actual Force Levels of U.S. Armed Forces: 1952 –1956), in Robert J. Watson, *The Joint Chiefs of Staff and National Policy, 1953–1954*, 82, 84.
9. Table 12 (FY 1953 Appropriations), in Condit, *Test of War*, 284.
10. Russell F. Weigley, *History of the United States Army*, 501-02.
11. Col. D. V. Johnson [Plans and Operations Division, Army staff], "Peacetime Tasks and Force Deployments," Army Budgetary Presentation before JCS on Review of Plans, Phase II, Pt. 1, for FY 1951 Budget, 16 June 1949, vol. 1, 6-7, 17, folder 111, 1949, box 24, entry 24, RG 335.
12. Andrew J. Birtle, "The Korean War: Years of Stalemate, July 1951–July 1953," 5; and Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 117.
13. Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 115.
14. Ibid., 83-84, 88, 96.
15. Table 4 (Forces in Being, 1950–1952), in Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 71. Tanks were also organic to each infantry division.
16. Ibid.
17. Robert A. Doughty, *The Evolution of U.S. Army Tactical Doctrine, 1946–1976*, 2-12.
18. Ibid., 12; Research and Development Board, RDB 236/1 (Research and Development), 16 July 1952, 21–22, folder CD 381, War Plans, NSC 114, 1952 (Mar.–Aug.), box 362, entry 199 (Confidential Through Top Secret Subject Correspondence File, 1947–1953), RG 330; and James M. Gavin, *War and Peace in the Space Age*, 113-15. In 1949, Gavin, then a major general and while assigned to the Weapons Systems Evaluation Group, conducted a study of the possible tactical employment of nuclear weapons.
19. Memo, Gen. J. E. Hull for Mr. Pace, 5 October 1951, folder 471.6, box 775, entry 2 (Records of the Office of the Chief of Staff, Decimal File), RG 319 (Records of the Army Staff), Archives II.
20. Tab B (Brief of Draft FM 100-31, Tactical Use of Atomic Weapons) to staff summary sheet, Maj. Gen. Reuben E. Jenkins, Assistant Chief of Staff, G–3, for Chief of Staff, 17 August 1951, sub: Responsibilities in Connection with the Employment of Atomic Missiles, ibid.
21. Tab F (Current Plans for Employment of Atomic Missiles in Maneuvers), ibid.
22. Doughty, *Army Tactical Doctrine*, 13-14; and Boyd L. Dastrup, *King of Battle: A Branch History of the U.S. Army's Field Artillery,* 26.
23. James E. Hewes, Jr., *From Root to McNamara: Army Organization and Administration, 1900–1963*, 158-60; and Weigley, *United States Army*, 587-88.
24. Hewes, *Root to McNamara*, 68, 72-74, 90-91, 158-60.
25. Ibid., 158, 172, 207-08, and chart 18 (Organization of the Department of the Army, 11 April 1950). In 1954, the position of the assistant chief of staff, G–4, logistics, was redesignated the deputy chief of staff, logistics.
26. Weigley, *United States Army*, 588.
27. Hewes, *Root to McNamara*, 161; and James A. Huston, *Guns and Butter, Powder and Rice: U.S. Army Logistics in the Korean War*, 49-51.
28. Huston, *Guns and Butter*, 50.
29. Ordnance Corps pamphlet, *Procurement and Production: Program, Policies and Procedures, FY 1953*, November 1952, 1, 4, 6, folder 400.12, box 765, entry 2, RG 319.
30. Hewes, *Root to McNamara*, 272-78.
31. Robert W. Coakley and Richard C. Kugler, assisted by Vincent H. Demma, "Historical Summary of the Evolution of U.S. Army Test and Evaluation System—World War II to the Present," Office of the Chief of Military History, Department of the Army, December 1965, 1-6, copy in U.S. Army Center of Military History library and archives, Fort Lesley J. McNair, D.C. [hereafter CMH], call no. 2-3.7, AC.R; and Hewes, *Root to McNamara*, 171-72.
32. Hewes, *Root to McNamara*, 188, 193, 199, 212, 218-19.
33. Minutes, staff conference, Service, Supply, and Procurement Division, 24 March 1947, 11,

folder Minutes SS & P Div. Staff Conferences, box 72, Papers of Lt. Gen. LeRoy Lutes, U.S. Army, RG 200 (National Archives Gift Collection), Archives II.
34. James W. Bragg, *Development of the Corporal: The Embryo of the Army Missile Program*, xiv.
35. Carl H. Builder, *The Masks of War: American Military Styles in Strategy and Analysis*, 24. According to Builder, "Army people have historically taken greater pride in the basic skills of soldiering than in their equipment. Until the last few decades, the Army was notorious for its reluctance to embrace new technologies or methods. The Army took great pride in the marksmanship of the citizen soldier and clung to a marksman's rifle (the M–14) whereas the Air Force, as might be expected, quickly embraced the high-technology, volume-of-fire approach embodied in the Stoner AR–15 (later known as the M–16) rifle. . . . Of late, however, the Army seems to be moving toward the other services in the attachment to machines."
36. Using technology to offset manpower advantage is a point made repeatedly in the semiannual reports of the secretary of the Army. See, for example, Semiannual Report of the Secretary of the Army, January 1 to June 30, 1950, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1950*, 67, 72; Semiannual Report of the Secretary of the Army, January 1, 1951, to June 30, 1951, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1951*, 81; Semiannual Report of the Secretary of the Army, January 1, 1952, to June 30, 1952, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1952*; Semiannual Report of the Secretary of the Army, July 1–December 31, 1952, in Department of Defense, *Semiannual Report of the Secretary of Defense, July 1 to December 31, 1952*, 16; *Semiannual* Report of the Secretary of the Army, January 1, 1953, to June 30, 1953, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1953*, 129.
37. Headquarters, Army Ground Forces, "Report of Officers Convened to Study the Equipment of the Post War Army, Part I, Board Report and Annexes," 20 June 1945, 4, box 18, Personal-Official File, 1927–1953, Papers of Maj. Gen. John K. Christmas, U.S. Army, RG 200. A similar equipment review board, reporting in May 1946, proclaimed that "Scientific research is a paramount factor in National Defense." See War Department, "Report of the War Department Equipment Board," 29 May 1946, 3, box 168, entry 243 (Records of the Research and Development Division, Decimal File), RG 319.
38. Memo, Dwight D. Eisenhower for Directors and Chiefs of War Department, General and Special Staff Divisions and Bureaus, and the Commanding Generals of the Major Commands, 30 April 1946, sub: Scientific and Technological Resources as Military Assets, *The Papers of Dwight D. Eisenhower*, Vol. VII, *The Chief of Staff*, 1046-49 (quotation, 1047).
39. War Department General Staff, "Existing Major Policies of the War Department as of 7 December 1946," box 75, Numbered Publications and Reports, Papers of Lt. Gen. LeRoy Lutes, U.S. Army, RG 200.
40. Table (Research and Development Amounts Requested of Congress and Amounts Appropriated), 9 June 1953, atch to memo, W. H. Mautz, Director, Economic and Security Estimates Division, OSD, for Gordon Nease, Senate Appropriations Committee, 11 June 1953, sub: Budget Requests and Appropriations for Research and Development, folder Revised FY 1954 Budget, box 7, Budget Files, FY 1954, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO.
41. Table (Expenditures for Direct Costs of Research and Development, Fiscal Years 1940–1950), 8 June 1953, ibid.
42. Table (Research and Development Amounts Requested of Congress and Amounts Appropriated), 9 June 1953.
43. Ltr, Kenneth C. Royall to the Secretary of Defense, 28 September 1948, folder 400.112, Research and Development, box 151, entry 26 (Office of the Under Secretary of the Army; Security-Classified General Correspondence, 1947–1954), RG 335. See also memo, Maj. Gen. William O. Reeder, Proxy Department of the Army Member, RDB, for Chairman, Research and Development Board, 19 August 1948, sub: Comments on RDB 159/3, Research and

Development Requirements for FY 1950, folder 334, Research and Development Board, box 166, entry 243, RG 319; and memo, Maj. Gen. A. C. McAuliffe, Deputy Director of Research and Development, Army General Staff, for Chairman, Research and Development Board, 7 September 1948, sub: Secretary of Defense Request for Project Information, folder 400.112, Projects, box 177, ibid.

44. Memo, Maj. Gen. Ward H. Maris, Deputy Assistant Chief of Staff, G–4, for Research and Development, for the Under Secretary of the Army A. S. Alexander, 21 June 1950, sub: Conversations with Mr. Dernly of DoD Management Committee, folder 400.112, box 151, entry 26, RG 335.

45. Table (Research and Development Amounts Requested of Congress and Amounts Appropriated), 9 June 1953.

46. For the R&D figures, see ibid.; for the annual budget figures, see the tables in Rearden, *Formative Years,* 333, 360, and Condit, *Test of War*, 241, 259, 304.

47. Table (Research and Development Personnel, 30 June 1947–30 June 1949), in Logistics Division, General Staff, "Research and Development Analysis," 30 June 1949, 7, folder 334, R&D Program, box 26, entry 24, RG 335. In comparison, 22,146 Air Force personnel were involved in research and development activities at the end of March 1948. See Director of Research and Development, United States Air Force, Quarterly Personnel Report, "United States Air Force Personnel Engaged in Research and Development Activities (as of 31 March 1948)," folder 319.1, R&D Personnel, box 152, entry 243, RG 319.

48. Table (Research and Development Personnel, 30 June 1947–30 June 1949), 7.

49. Department of the Army, "Annual Report of the Office of The Assistant Secretary of the Army (to the Secretary of the Army for the Period of 1 July 1948 to 30 June 1949)," 51, folder 319.1 (19 Jan 50), box 583, entry 2, RG 319; and Semiannual Report of the Secretary of the Army, July 1–December 31, 1949, in Department of Defense, *Semiannual Report of the Secretary of Defense, July 1 to December 31, 1949*, 146.

50. Charles R. Shrader, *History of Operations Research in the United States Army*, Vol. I, *1942–1962*, 64-6.

51. Operations Research Office, Johns Hopkins University, "Semiannual Report," vol. 2, no. 3, 31 December 1949, folder OUSA, 319.1, Reports, box 25, entry 24, RG 335.

52. Ltr, Ellis A. Johnson, Director, Operations Research Office, to Commander-in-Chief, Far East Command, 18 September 1950, sub: Far East Command Operations Research Problems, folder 201-45, Orgn & Functions, R&D Div, Opns Rsch Ofc, 1948–50, box 3, entry 40 (Records of the Office of the Chief of Research; Records Relating to the Organization of Army Research and Development Activities, 1943–1960), RG 319; and Semiannual Report of the Secretary of the Army, January 1, 1952, to June 30, 1952, 86.

53. Research and Development Board, "Budget and Fiscal Information on Research and Development Program, FY 1952–FY 1954" (RDB 106/25), 25 September 1952, 15, folder RDB 106.7, Fiscal Year 1954, box 497, entry 341 (Research and Development Board), RG 330.

54. Memo, Dwight D. Eisenhower for the Secretary of War, 30 August 1946, sub: War Department Advisory Panel, *The Papers of Dwight D. Eisenhower*, Vol. VII, *The Chief of Staff*, 1264-65.

55. Memo, Col. Bryan Evans, Acting Deputy Director for Research and Development, G–4, for Colonel Heiss, 24 February 1948, sub: Army Research Advisory Panel, folder 334 Army Research Advisory Panel, box 164, entry 243, RG 319; memo, Lt. Gen. T. B. Larkin, Assistant Chief of Staff, G–4, for Mr. Alexander [under secretary of the Army], 18 November 1950, sub: Research and Development, folder 400.112, Research and Development, box 151, entry 26, RG 319; and "Utilization of Scientific and Technological Personnel Within the Army," atch to memo, Col. L. S. Griffing, Chief, Research Branch, Research and Development Division; Office, Assistant Chief of Staff, G–4, for Mr. Green, Colonel Buckley, General Maris, 12 February 1951, sub: Utilization of Scientific and Technological Personnel Within the Army, folder 201-45, Reorgn of R&D, Corres. Leading to, 1952, box 4, entry 40, RG 319.

56. "Utilization of Scientific and Technological Personnel Within the Army," 12 February 1951.
57. Table (Research and Development Projects, as of 30 June 1949), in Logistics Division, General Staff, "Research and Development Analysis," 30 June 1949, 4; table (Summary of Research & Development Project Actions During 1st Qtr FY 1952), in Office, Assistant Chief of Staff, G–4, Logistical Operations Summary, 1 October 1951, 4, box 40, entry 24, RG 335; and Semiannual Report of the Secretary of the Army, January 1, 1953, to June 30, 1953, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1953*, 86.
58. According to the Logistics Division report of 30 June 1949 cited in the previous note (p. 4), the sharp drop in the number of projects from FY 1948 to FY 1949 was caused largely by "the consolidation of subprojects into projects as a result of clarification of project definitions within the Ordnance Department."
59. Hewes, *Root to McNamara*, 157.
60. Ibid., 120-21.
61. L. Van Naisawald, "The History of Army R&D Organization and Program, Part I—Organization," U.S. Army Research and Development Organization, [1962], 14, copy in CMH library and archives, call no. 2-2.5 AA 1.
62. Memo, Lt. Gen. W. H. Simpson for the Chief of Staff, 2 February 1946, folder 400.112, box 764, entry 2, RG 319.
63. Memo, Eisenhower for Directors and Chiefs of War Department, General and Special Staff Divisions and Bureaus, and the Commanding Generals of the Major Commands, 30 April 1946, 1048. Edward L. Bowles, a colleague of Bush's at MIT before World War II and in the Office of Scientific Research and Development during the war, drafted the Eisenhower memorandum. For Bowles' role in writing this paper and his considerable influence on the organization of scientific effort in both the Army and the Army Air Forces after the war, see Martin J. Collins, *Cold War Laboratory: RAND, the Air Force, and the American State, 1945–1950*, esp. 1-68.
64. The Air Force Scientific Advisory Board had been established on 1 December 1944, initially as the AAF Scientific Advisory Group. The Naval Research Advisory Committee was organized in late 1946. (See chaps. 5 and 7, respectively.)
65. Hewes, *Root to McNamara*, 172; and Van Naisawald, "Army R&D Organization and Program," 23.
66. National Military Establishment, *Annual Report of the Secretary of the Army, 1948*, 41.
67. Excerpt from cable, Lt. Gen. Henry S. Aurand, Commanding General, U.S. Army, Pacific, to the Chief of Staff, 26 October 1951, in "Statements of Senior Army Officers and Prominent Civilians Regarding Research and Development to Date," [late 1954], folder 201-45, R&D Div Orgn, 1951–1954, box 3, entry 40, RG 319. A memorandum for the secretary of the General Staff, prepared in the Office of the Comptroller of the Army, speculated that Aurand, by the time he was named to take over the Logistics Division, was no longer convinced of the need to separate R&D organizationally and simply took the Research and Development Division with him. See memo, Col. G. J. Zimmerman, Chief, Management Division, Comptroller of the Army, for the Secretary, General Staff, 23 August 1950, sub: History of Research and Development Organization, folder 201-45, History of R&D Orgn, 1943–1950, box 1, entry 40, RG 319.
68. Memo, Col. Bryan Evans, Acting Deputy Director for Research and Development, for Colonel Heiss, 24 February 1948, sub: Army Research Advisory Panel; memo, Gordon Gray, Assistant Secretary of the Army, for Colonel Heiss [Col. G. K. Heiss, executive assistant to the assistant secretary of the Army], 25 February 1948, sub: Army Research Advisory Panel (quotation); memo, Col. Oscar A. Heinlein, Assistant Chief, Research Branch, Service, Supply, and Procurement Division, for Maj. Gen. A. C. McAuliffe, Col. Bryan Evans, 1 March 1948, sub: Army Research Advisory Panel (quotation); and memo, Maj. Gen. A. C. McAuliffe, Deputy Director for Research and Development, for the Assistant Secretary of the Army, 5 March 1948,

sub: Army Research Advisory Panel: all in folder 334 Army Research Advisory Panel, box 164, entry 243, RG 319.

69. War Department, "Report of the War Department Equipment Board," 29 May 1946, 4.

70. General Staff, "Department of the Army Research and Development Program, Fiscal Year 1950," May 1948, 10, folder 400.112, Research and Development, 1947 and Jan. and Feb. 1948, box 23, entry 34 (Office of The Assistant Secretary of the Army, Security-Classified General Correspondence, 1947–1948), RG 335; "Remarks of the Director and Deputy Directors before the Bureau of the Budget, Fiscal Year 1950 Budget," 28 October 1948, 9-10, folder 111, box 144, entry 243, RG 319; and Annual Report of the Secretary of the Army, Fiscal Year 1949, in Department of Defense, *Second Report of the Secretary of Defense and the Annual Reports of the Secretary of the Army, Secretary of the Navy, Secretary of the Air Force for the Fiscal Year 1949*, 160.

71. See "Review by the Deputy Secretary of Defense of Military Programs Involved in the Implementation of NSC 68," 20 October 1950, 14, folder CD 381 (War Plans, NSC 68), October 1950, box 201, entry 199, RG 330.

72. Lt. Gen. Henry S. Aurand, "Research and Development in the Army," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 3 November 1947, 6, folder Reading File, 1948, Dr. Cassidy, Logistics, box 93, entry 221 (Records of Dr. Elliott Cassidy Accumulated While Serving as Historian and Special Assistant to the Chairman of the Munitions Board, 1948–1953), RG 330.

73. Memo, Kenneth C. Royall, Secretary of the Army, for Lt. Gen. H. S. Aurand, Director, Logistics Division, 17 April 1948; and memo, Lt. Gen. H. S. Aurand for the Secretary of the Army, 23 April 1948, sub: Guided Missile Progress: both in folder 471.94, box 460, entry 2, RG 319. The six missiles were the surface-to-air Nike and five surface-to-surface missiles (with approximate ranges in parentheses): Hermes A1 (50 miles); Corporal E (75 miles); Hermes A3 (150 miles); Hermes II (500 miles); and Hermes B2 (500–1,500 miles). See tab B to Guided Missile Briefing for the Chief of Staff, U.S. Army, 1 November 1948, folder 471, box 460, entry 2, RG 319.

74. "Review by the Deputy Secretary of Defense of Military Programs Involved in the Implementation of NSC 68," 20 October 1950, 22; and "Army Tentative Plans—FY 1952, Part II—Budget Summary," 1 April 1950, 57, folder 111 FY 1952, box 24, entry 24, RG 335.

75. "Review by the Deputy Secretary of Defense of Military Programs Involved in the Implementation of NSC 68," 20 October 1950, 15; *Annual Report of the Secretary of the Army, 1948*, 213; and *Annual Report of the Secretary of the Army, Fiscal Year 1949,* 153, 160.

76. [Office of the Secretary of the Army], "Report on Organization and Administration of the Army Research and Development Program," January 1951, 5-8, folder 201-45, Orgn & Functions, R&D Div., 1951, Kilgo Rpt, box 3, entry 40, RG 319.

77. "Research and Development, Department of the Army," encl. to staff summary sheet, Col. W. T. O'Reilly, Chief, Plans and Control Office, Research and Development Group, Logistics Division, for Chief, Research and Development Group, 28 January 1949, sub: Presentation by the Technical Services, folder 001, Presentations, box 234, entry 243, RG 319.

78. "Report on Organization and Administration of the Army Research and Development Program," January 1951, 28-29.

79. Item no. 12 (The Directive Program for Army Research and Development), minutes, Army Research and Development Council meeting no. 2, 16 March 1948, folder 334, Army R&D Council, box 159, entry 243, RG 319.

80. "Report on Organization and Administration of the Army Research and Development Program," January 1951, 6.

81. Table (Master Plan Obligations by Categories, FY 1949 Program), in Logistics Division, General Staff, "Research and Development Analysis, 30 June 1949," 11.

82. Staff summary sheet, Maj. Gen. Charles G. Bolté, Director of Plans and Operations, for the Chief of Staff, 29 June 1949, sub: Development of Guided Missiles with Atomic Warheads,

folder 471.94, box 542, entry 2, RG 319.
83. Tab A (Staff study, Manhattan-Type Project for Air Defense, 25 January 1951) to staff summary sheet, Maj. Gen. Maxwell D. Taylor, Acting Assistant Chief of Staff, G–3, for the Chief of Staff, Under Secretary of the Army, Secretary of the Army, 6 February 1951, sub: Improvement of Army's Weapon Systems, folder 334 A-Z, 1951–1952, box 16, entry 4 (Records of the Office of the Chief of Staff, Top Secret Correspondence, 1948–1962), RG 319.
84. Memo, Secretary of the Army Gordon Gray for the Chief of Staff, 8 April 1950, sub: Research and Development, folder 400.112, box 614, entry 2, RG 319.
85. Under Secretary of the Army Tracy S. Voorhees et al., "Report to the Secretary of the Army," 19 April 1950, folder OUSA, 319.1, Reports, box 25, entry 24, RG 335 [hereafter Voorhees report, 19 April 1950]. In addition to Voorhees and Bush, the other members of the study group were Archibald S. Alexander, assistant secretary of the Army; Lt. Gen. Manton S. Eddy, soon to become deputy commander, U.S. Army European Command; Lt. Gen. Alfred M. Gruenther, deputy chief of staff for plans; Lt. Gen. Thomas B. Larkin, assistant chief of staff, G–4; Maj. Gen. A. C. McAuliffe, chief of the Chemical Corps; and Brig. Gen. Rex W. Beasley, assistant chief of staff for research and development, Army Field Forces.
86. Voorhees report, 19 April 1950, 6.
87. Ibid., 2-4 (Bush quotation, 2).
88. Ibid., 5 (underlining in original).
89. For the preference of some scientists for a defense-oriented military strategy during the late 1940s and early 1950s, see Gregg Herken, *Counsels of War*, 61-67.
90. Concerning the tank vs. antitank issue, the Army clearly favored the tank. In May 1946, the Stilwell Board proclaimed: "The best anti-tank weapon is a better tank." In June 1950, the report of the Department of the Army Armored Panel stated: "The modern tank will not be made obsolescent or obsolete by any impending developments in the field of antitank measures. Rather the prospective perfection of such better weapons should increase the striking power of the modern tank." See War Department, "Report of the War Department Equipment Board," 29 May 1946, 12; Department of the Army, "The Report of Department of the Army Armored Panel," 30 June 1950, 3, folder OUSA, 319.1, Reports, box 25, entry 24, RG 335; and Doughty, *Army Tactical Doctrine*, 4-5. For the Army's experience with the tank destroyer in World War II, see Robert Stewart Cameron, *Mobility, Shock, and Firepower: The Emergence of the U.S. Army's Armor Branch, 1917–1945*, 405-33, 495-507.
91. Encl. no. 2 (Emergency Readiness of R&D Program) to staff summary sheet, Col. W. T. O'Reilly, Chief, R&D Planning Branch, Research and Development Division, G–4, for Chief, Control Office, G–4, 8 Aug 50, sub: Emergency Readiness, folders Readiness, and Presenting Agencies' Analysis of Current Status of Army Readiness Based on Presentation of 5 June 1950: both in box 29, entry 24, RG 335. The secretary of the Army's semiannual report for January through June 1950 indicated that the Army's R&D program had been realigned but without being specific about the nature of the realignment. See Semiannual Report of the Secretary of the Army, January 1 to June 30, 1950, 73.
92. Memo, 1st. Lt. Richard K. Winslow for Mr. Alexander [under secretary of the Army], 28 February 1951, sub: Digest of the D/A Research and Development Program for FY 51; and Assistant Chief of Staff, G–4, Department of the Army Research and Development Program, FY 1951, 20 February 1951, 19, 72, 126, 186: both in folder 334, R&D Program, box 36, entry 24, RG 335.
93. Annex A (Strategic Guidance to Army Research and Development Agencies), Department of the Army Research and Development Program, FY 1951, 20 February 1951, 268.
94. Memo, Winslow for Alexander, 28 February 1951.
95. Research and Development Board, "Budget and Fiscal Information on Research and Development Program, FY 1952–1954," 25 September 1952, 2-4, folder RDB 106.7, Fiscal Year 1954, box 497, entry 341, RG 330.
96. Table (Research and Development Amounts Requested of Congress and Amounts

Appropriated), 9 June 1953.
97. Ltr, Vannevar Bush to Under Secretary of the Army Tracy S. Voorhees, 24 April 1950, folder OUSA, 319.1, Reports, box 25, entry 24, RG 335.
98. Memo, Under Secretary of the Army Archibald S. Alexander for the Secretary of the Army, 26 May 1950, sub: Army Organization for Research and Development, folder 400.112, Research and Development, box 151, entry 26, RG 335. In March 1950, Maj. Gen. Ward H. Maris replaced Maj. Gen. Charles G. Helmick as the head of R&D in G–4. According to Alexander, "The General Staff organization should produce better results now that G–4 has obtained a new Deputy to head his Research and Development Division. The former chief [Helmick] was not sufficiently aggressive or imaginative, and if the top man with responsibilities for research only has these failings, no matter where that top level is the research will not be satisfactory."
99. Van Naisawald, "The History of Army R&D Organization and Program," 29.
100. "Report on Organization and Administration of the Army Research and Development Program," January 1951, 7-11, 28-29, 31-32 (quotation on p. 11).
101. Ibid., 24-25, 50-52, 54. Quotations from p. 51 and pp. 24-25.
102. Memo, Frank Pace, Jr., for the Chief of Staff, 29 January 1951, sub: Organization and Administration of the Army Research and Development Program, folder 201-45, History of R&D Orgn, 1943–1950, box 1, entry 40, RG 319.
103. Tab B (Resume of Recommendations) and tab F (G–4 Comments) to staff summary sheet, Lt. Gen. T. B. Larkin, Assistant Chief of Staff, G–4, for the Chief of Staff, 12 February 1951, sub: Organization and Administration of the Army Research and Development Program, folder 201-45, Orgn & Functions, R&D Div, 1951, Kilgo Report, box 3, entry 40, RG 319.
104. Memo, Gen. J. Lawton Collins for the Secretary of the Army, 19 February 1951, sub: Report on Organization and Administration of the Army Research and Development Program, ibid.
105. Memo, Archibald S. Alexander for the Secretary of the Army, 14 March 1951, sub: Organization and Administration of the Army Research and Development Program, ibid.
106. Van Naisawald, "The History of Army R&D Organization and Program," 36-37.
107. Ibid., 39-59, esp. 57-59; quotation from p. 43. Under the reorganization, G–3 took over supervision of the Operations Research Office from G–4.
108. Ibid., 61.
109. Ibid., 64-65, 70-71.
110. Ltr, Under Secretary of the Army Karl R. Bendetsen to Secretary of Defense, 25 September 1952, 4, folder Bendetsen Ltr, Sept. 25, 1952, box 517, Subject Files, OSD/HO. Bendetsen provided a copy of his letter to Lovett to Secretary Pace.
111. Excerpt from California Institute of Technology contract, in memo, William A. Fowler for Staff Members, [spring 1951], folder Vista Contract with Armed Services, box 5, Manuscript and Background Data, 1951–52, Project Vista, RG 200; and Gavin, *War and Peace*, 129-33. According to Gavin, the idea for Vista was a result of conversations with several scientists who accompanied him on a trip to Korea in the fall of 1950 to investigate problems being experienced with tactical air support of ground operations. One of the members of the group was Dr. Charles C. Lauritsen of Caltech.
112. Thomas P. Hughes, *Rescuing Prometheus*, 23-27.
113. J. R. Marvin and F. J. Weyl, "The Summer Study," *Naval Research Reviews* 19 (August 1966): 1-28; Harvey M. Sapolsky, *Science and the Navy: The History of the Office of Naval Research*, 111-12; and Hughes, *Rescuing Prometheus*, 24-26
114. Memo, William A. Fowler for Group Chairmen, 5 February 1952, sub: Scientific Effort Required for Project Vista, folder Correspondence, Vista (50, 604-), box 3, Manuscript and Background Data, 1951–1952, Project Vista, RG 200.
115. For DuBridge's role, see W. Patrick McCray, "Project Vista, Caltech, and the Dilemmas of Lee DuBridge," *Historical Studies in the Physical and Biological Sciences* 34, pt. 2 (2004): 339-70.

116. [List of participants], Project Vista, 21 August 1951, folder Staff Lists, Box 4, Manuscript and Background Data, 1951–1952, RG 200.
117. [List of staff groups and members], Project Vista, 23 July 1951, folder Staff Groups, ibid.; and Tentative Project Vista Itinerary as of 18 May 1951, and Tentative Schedule, Project Vista Group Visits to Field Installations, box 14, ibid.
118. The Air Force sent a large and high-ranking delegation to a conference at the Vista site that included a two-day discussion of tactical air support, 24–25 October 1951. Among the Air Force participants were the commanding general of the Air Research and Development Command, the deputy commander of Tactical Air Command, and the chief of the war plans division, as well as the assistant deputy chief of staff for development at Air Force headquarters. See tab A to memo, Lt. Col. J. H. Brakebill, Doctrine and Procedures Branch, for Chief, Organization and Training Division, G–3, 31 October 1951, sub: Record of Conferences Attended at Project Vista, folder 337, 1951–1952, box 17, entry 4, RG 319.
119. Phillip S. Meilinger, *Hoyt S. Vandenberg: The Life of a General*, 196-97; Gavin, *War and Peace*, 133-34; and Hanson W. Baldwin, "Experts Urge Tactical Air Might," *New York Times,* 5 June 1952: 13. General Collins met with DuBridge and other Vista leaders shortly after their presentation of the report's findings in Washington, D.C., on 18–19 February 1952. According to a summary of the meeting, the chief of staff stressed "the importance of the Vista conclusion . . . pertaining to control by tactical ground commanders of atomic weapons employed tactically. The relationship of this conclusion to the Army position on operational control of tactical air and the Army requirement for guided missiles was emphasized." See, encl. 1 (Project Vista Report) to memo, Col. M. F. Hass, Secretary of the General Staff, for the Vice Chief of Staff, 21 February 1952, sub: Briefs of Important Actions, folder 319.1, cases 8-19, 1951–1952, box 9, entry 4, RG 319.
120. Atch, List of Commenting Agencies on Project Vista, to memo, Brig. Gen. G. J. Higgins, Chief, Organization and Training Division, G–3 [and chairman of the General Staff ad hoc committee], for Assistant Chief of Staff, G–3, 14 April 1952, sub: Evaluation of Project Vista, folder 381, cases 36-55, 1951–1952, box 19, entry 4, RG 319.
121. Staff summary sheet, Maj. Gen. C. D. Eddleman, Assistant Chief of Staff, G–3, for the Chief of Staff, 18 September 1952, ibid.
122. Army General Staff Ad Hoc Committee, Evaluation of Project Vista, May 1952, Vista Recommendation, 7C4-C6, box 20, entry 4, RG 319.
123. Ibid., Vista Recommendation, 3D8-D7.
124. Ibid., Vista Recommendation, 3A5-A1.
125. Ibid., Vista Recommendation, 7B5-B6.
126. Ibid., Vista Recommendation, 7B5-B9.
127. Ibid., Vista Recommendation, 3F-F1.
128. Encl. 1 (Project Vista Report) to memo, Hass for the Vice Chief of Staff, 21 February 1952.
129. *United States Army Combat Developments Command: Origins and Formation*, Office of the Historian, Deputy Chief of Staff for Management and Resources, Headquarters, U.S. Army Combat Developments Command, Fort Belvoir, Va., May 1972, 3-6.
130. Gen. J. Lawton Collins, "Statement for Committee on Department of Defense Organization," 22 March 1953, 53, folder Collins, box 519, Subject Files, OSD/HO.
131. In March 1953, during the same session of the Committee on Department of Defense Organization in which General Collins spoke positively of Vista's role in the creation of the Army's Combat Development Group, he also responded with a one-word "No" to committee member Vannevar Bush's suggestion that "ever since the war the technical, the scientific aspect has been excluded from the considerations of strategy by practice."
132. Memo, Frank Pace, Jr., for the Chief of Staff, 29 July 1952, sub: Staff Comments on the Vista Report, folder 381, cases 36-55, 1951–1952, box 19, entry 4, RG 319.
133. Staff summary sheet, Maj. Gen. C. D. Eddleman, Assistant Chief of Staff, G–3, for the

Chief of Staff, 28 November 1952, sub: Project Vista Report Review, ibid. The Army considered its rejection of any Vista recommendation as casting the service in a bad light. Thus it did not declassify those portions of the report that it opposed, such as the suggestion that the Army stabilize the trajectory of large rockets and develop a shoulder-fired 37-mm. recoilless rifle. In contrast, the Army made much of the Vista proposal for a combat development group.
134. Army General Staff Ad Hoc Committee, Evaluation of Project Vista, May 1952, Vista Recommendation, 3E7-E1.
135. Memo, Brig. Gen. G. J. Higgins, Chief, Organization and Training Division, G–3, for General Eddleman [assistant chief of staff, G–3], 1 November 1951, sub: Report on Visit to Vista Project, Pasadena, California, folder 337, 1951–1952, box 17, entry 4, RG 319.
136. Army General Staff Ad Hoc Committee, Evaluation of Project Vista, May 1952, Vista Recommendation, 3E7-E1.
137. Ibid. In commenting on the Vista recommendations regarding Ontos, Third Army pointed out that the system had no offensive capability. Fifth Army thought the Ontos concept would adversely affect the Army's tank program.
138. Memo, Frank Pace, Jr., for the Chief of Staff, 6 October 1951, sub: Army Tank and Anti-Tank Program, folder 470.8, cases 1-6, box 774, entry 2, RG 319. Two weeks later, Lt. Gen. Maxwell D. Taylor, deputy chief of staff for operations and administration, replied that the project had been given "the highest priority in accordance with your wishes." See, memo, Lt. Gen. Maxwell D. Taylor for the Secretary of the Army, 19 October 1951, sub: Army Tank and Antitank Program, ibid.
139. Fred P. Unruh, "Ontos Vehicles," Ordnance Tank and Automotive Command, U.S. Army Ordnance Corps, 17 November 1953, 8-11, box 2, entry 1021 (Records of the Office of the Chief of Ordnance; Executive Office; Historical Branch; Military Historians Files, 1947–1961), RG 156 (Records of the Office of the Chief of Ordnance), Archives II.
140. Tab D (Ontos) to memo, G–4 for the Chief of Staff (Attn: Deputy Chief of Staff for Operations and Administration), [January] 1953, sub: Report of Status of Development, folder 400, cases 1-25, box 826, entry 2, RG 319. There were several versions of Ontos. The one referenced in this chapter is the T165E1, the model equipped with six 106-mm. recoilless rifles that the Army was considering for production in 1953. At the beginning of Ontos development, the system was to be equipped with 105-mm. recoilless rifles.
141. Memorandum for record, Col. W. G. Dolvin, G–4, 18 June 1953, sub: Briefing for the Secretary of the Army and Assistant Secretary of the Army (Mat) on the Light Tank Family of Vehicles, folder 470.8, box 830, entry 2, RG 319.
142. Ltr, Lt. Gen. John E. Dahlquist, Chief, Army Field Forces, to Gen. Matthew B. Ridgway, Chief of Staff, 29 September 1953, folder 470.8, box 831, entry 2, RG 319.
143. Tab C (BAT) to memo, G–4 for the Chief of Staff (Attn: Deputy Chief of Staff for Operations and Administration), [January] 1953.
144. Memo, Lt. Col. Nicholas C. Biersteker, G–4, for Lt. Col. Cross, Office, Chief of Staff, 7 September 1951, sub: Infantry Fighter, folder 470.8, cases 7-20, box 774, entry 2, RG 319. By mid-1953 the projected cost of the Ontos had risen to $58,000. See memorandum for record, Col. W. G. Dolvin, G–4, 12 June 1953, sub: Briefing for the Under Secretary of the Army on the Delay in the Delivery of Pilot Ontos, T165E1, Vehicles, folder 470.8, box 831, entry 2, RG 319. For the cost of the M47, see Huston, *Guns and Butter*, 178. Each T41 cost $190,000. See ltr, Gen. Mark W. Clark, Chief, Army Field Forces, to Gen. J. Lawton Collins, 14 September 1951, folder 470.8, cases 7-20, box 774, entry 2, RG 319.
145. Memorandum for record, Lt. Col. Calvin A. Heath, Executive, Procurement Division, G–4, 7 November 1951, sub: Presentation of Tank Program for the Secretary of the Army, folder 470.8, cases 21-35, box 774, entry 2, RG 319.
146. Staff summary sheet, Lt. Gen. T. B. Larkin, Assistant Chief of Staff, G–4, for the Deputy Chief Staff, Operations and Administration and the Vice Chief of Staff, 18 July 1952, sub: Development in Antitank Weapons, folder 470.8, box 22, entry 4, RG 319.

147. Ltr, General M. B. Ridgway to Gen. J. Lawton Collins, 19 July 1952, ibid. Ridgway sent the letter to Collins following a briefing he and his staff had received from Maj. Gen. Leslie E. Simon, the assistant chief of ordnance, who was an ardent advocate for Ontos and BAT. A staff officer informed Vice Chief of Staff General John E. Hull and Deputy Chief of Staff for Operations and Administration Lt. Gen. A. C. McAuliffe in August 1953: "General Simon has taken a rosy view of the Ontos program from its inception, and has on several occasions made over-optimistic predictions which have not been borne out by events. . . . General Simon's presentation to General Ridgway last September [sic July] at Hq SHAPE [Supreme Headquarters Allied Powers Europe] nearly resulted in a Sec. Army decision to telescope development and mass produce." See memo, Col. H. K. Benson, Jr., for General Hull, General McAuliffe, 24 August 1953, folder 470.8, box 831, entry 2, RG 319.
148. Ltr, Gen. J. Lawton Collins to Gen. Matthew B. Ridgway, 2 August 1952, folder 470.8, box 22, entry 4, RG 319.
149. Msg, S 2225 to CSUSA, 082111Z Aug 52. Personal for Collins from CINCUSAREUR Heidelberg, Germany, sgd Handy from Pace, ibid.
150. Encl. 18 to memo, Brig. Gen. John C. Oakes, Secretary of the General Staff, for the Deputy Chief of Staff for Operations and Administration, 26 August 1952, sub: Summaries of Important Actions, folder 319.1, cases 8-19, box 9, entry 4, RG 319.
151. Memorandum for record, Col. Michael Buckley, Acting Assistant Deputy, Assistant Chief of Staff for Research and Development, G–4, 28 August 1952, sub: Presentation to Chief of Staff on Pros and Cons of Telescoping Development and Production of the Ontos and BAT Weapons, folder 470.8, box 831, entry 2, RG 319. Major General Simon, assistant chief of ordnance, gave the briefing.
152. Memorandum for record, Maj. Gen. Leslie E. Simon, Assistant Chief of Ordnance, 5 September 1952, sub: Presentation to the Secretary of the Army on Pros and Cons of Telescoping Development and Production of Ontos and BAT Weapons, ibid. Major General Simon was again the briefer.
153. Memorandum for record, Col. W. G. Dolvin, G–4, 12 January 1953, sub: Briefing for the Secretary of the Army on Tests of BAT and Ontos Vehicles, ibid. Colonel Dolvin gave the briefing.
154. Ibid.
155. Ibid.
156. Kenneth W. Estes, *Marines under Armor: The Marine Corps and the Armored Fighting Vehicle, 1916–2000*, 164-71.
157. *Annual Report of the Secretary of the Army, 1948*, 192; *Annual Report of the Office of The Assistant Secretary of the Army . . . 1 July 1948 to 30 June 1949*, 2; and Department of the Army, *Annual Report of the Office of the Under Secretary of the Army for the Period of 1 July 1949 to 30 June 1950*, 3, folder 319.1, OUSA, Annual Report, 1950, box 118, entry 26, RG 335.
158. See the tables in Condit, *Test of War*, 241, 259, 284.
159. Assistant Secretary of Defense (Supply & Logistics), *Munitions Production Report*, 21 August 1953, 81-83, 91, 99, folder Munitions Production Reports, box 87, entry 220 (Historical Manuscripts and Papers Containing Background Data Re: Munitions Board and Industrial Mobilization Programs, 1947–1953), RG 330. The figure of 11,706 tanks includes 369 M46 Pattons purchased with FY 1951 funds (800 had been funded in FY 1950).
160. Annual budget figures are from *Annual Report of the Secretary of the Army, 1948*, 280 ($4.8 billion); and Rearden, *Formative Years*, 333 ($5.8 billion, FY 1949), 360 ($4.2 billion, FY 1950).
161. *Annual Report of the Office of The Assistant Secretary of the Army . . . 1 July 1948 to 30 June 1949*, 2.
162. Progress Reports and Statistics, Office of the Secretary of Defense, table IV (Army Procurement of Equipment), 24 March 1949, 14, encl. to memo, Maj. Gen. Edmond H. Leavey, Army Comptroller, for Secretary, General Staff, 25 April 1949, sub: Changes in the Army, Navy, and Air Force, 30 June 1947 to 30 June 1950, folder 320, Unification, box 121, entry 26, RG

335; and "Army Tentative Plans—FY 1952, Part II—Budget Summary," 1 April 1950, 29.
163. Huston, *Guns and Butter*, 33.
164. Ibid., 28; and tab B (Major Factors Causing Equipment Shortages) to memo, Maj. Gen. Reuben E. Jenkins, Assistant Chief of Staff, G–3, for the Chief of Staff (Attn: General Taylor), 17 October 1951, folder 400, cases 46-58, box 762, entry 2, RG 319.
165. Lt. Gen. Henry S. Aurand, Presentation Made to the Secretary of Defense on Inventory Account of Army Equipment, 15 September 1948, 10, folder 400, Inventory Control Equipment, box 23, entry 34, RG 335.
166. Table IV (Army Procurement of Equipment) in encl. (Changes in the Army, 30 June 1947–30 June 1950), 14, to memo, Leavey for Secretary, General Staff, 25 April 1949.
167. Ibid., encl. (Changes in the Army, 30 June 1947–30 June 1950), 13.
168. Ibid., table IV (Army Procurement of Equipment), 14.
169. Robert Lloyd Kelley, "Army Antiaircraft in Air Defense, 1946 to 1954," Directorate of Historical Services, Headquarters, Air Defense Command, Colorado Springs, Colo., 30 June 1954, 62-63.
170. "Army Tentative Plans—FY 1952, Part II—Budget Summary," 1 April 1950, 34, 79.
171. Encl. to ltr, B. A. Monaghan, Counselor, Department of the Army, to Honorable Homer Ferguson, Chairman, Subcommittee on Armed Services, Committee on Appropriations, United States Senate, 10 June 1953, folder 470.8, box 831, entry 2, RG 319.
172. Huston, *Guns and Butter*, 177. The cross-drive transmission was equipped with a hydraulic torque converter in lieu of the conventional step-gear transmission with clutch. For an informative discussion of tank engines and transmissions during this period, see the document labeled "Enclosure 1, Tank Development Trends," [probably early 1951, Ordnance Department], folder 470.8, cases 36-up, box 774, entry 2, RG 319.
173. Encl. 3 (Interim Guidance Concerning 1957 Army Requirements and Objectives), 27 February 1950, 9, to staff summary sheet, Maj. Gen. W. H. Arnold, Chairman, Army Budget Advisory Committee, for Members, Army Budget Advisory Committee, 28 February 1950, sub: Meeting on 1950 Long Range Estimate of the Army, folder 111, 1950, box 24, entry 24, RG 335.
174. Maj. Gen. William O. Reeder, "Statement of the Department of the Army Materiel Plans for Fiscal Years 1951 through 1954 before the Hon. Robert A. Lovett, Deputy Secretary of Defense," 23 October 1950, folder OUSA, 320.2, box 24, entry 24, RG 335.
175. Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 39-40.
176. Ltr, Maj. Gen. Miles Reber, Chief of Legislative Liaison, to Honorable Carl Vinson, Chairman, Committee on Armed Services, House of Representatives, 21 April 1952, folder 400.12, box 765, entry 2, RG 319.
177. Tab E to memo, Col. M. F. Hass, Secretary of the General Staff, for General Collins, 9 February 1952, sub: Priorities of Work, folder 320, cases 23-34, 1951–1952, box 10, entry 4, RG 319. These figures represent total production for all claimants: the Army, the other services, and the allies under the Mutual Defense Assistance Program.
178. Memo, Archibald S. Alexander [for Secretary of the Army Frank Pace, Jr.] for the Deputy Secretary of Defense, 1 August 1951, folder 400.12, box 36, entry 24, RG 335.
179. Memo, Frank Pace, Jr., Secretary of the Army, for the Secretary of Defense, 13 March 1951, sub: Financing of Accelerated Army Procurement Program, folder CD 400.12, 1951, box 282, entry 199, RG 330; Presentation to Secretary of the Army Pace (Pt. III, Materiel Requirements by Procurement Division, G–4), 26 July 1951, folder 040, A-Z, box 3, entry 4, RG 319; tab B (Major Factors Causing Equipment Shortages) to memo, Jenkins for the Chief of Staff (Attn: General Taylor), 17 October 1951; encl. (Production Information and Obligation Rates) to staff summary sheet, Maj. Gen. John K. Christmas, Chief, Procurement Division, G–4, for the Under Secretary of the Army, 9 November 1951, sub: Appraisal of Procurement Program, folder 400.12, box 765, entry 2, RG 319; memo, Lt. Gen. Raymond S. McLain, Comptroller of the Army, for Under Secretary of the Army Karl R. Bendetsen, General

J. Lawton Collins, 30 April 1952, sub: Final Report, 3, folder Comptroller Organization and Functions, box 1, entry 29 (Records of the Assistant Secretary of the Army, General Management, 1950–1954, Office File), RG 335; memo, Lt. Gen. T. B. Larkin, Assistant Chief of Staff, G–4, for General Collins, 19 August 1952, sub: Memorandum from Secretary Lovett, 15 August 1952, on Change in Budgetary Policy, folder 400, cases 46-58, box 762, entry 2, RG 319; and Condit, *Test of War*, 258.

180. Presentation to Secretary of the Army Pace (Pt. III, Materiel Requirements by Procurement Division, G–4), 26 July 1951; and memo, Alexander [for Secretary of the Army Frank Pace, Jr.] for Deputy Secretary of Defense, 1 August 1951. By June 1952, the Department of Justice had approved the requests and all 24 committees were in operation. See, Pt. II, tab A (Report of Measures and Recommendations) to staff summary sheet, Lt. Gen. G. H. Decker, Comptroller of the Army, for the Secretary of the Army, Chief of Staff, 7 January 1953, sub: Major Recommendations for the Improvement of the Army, folder 320, cases 1-4, box 808, entry 2, RG 319.

181. Program Review and Analysis Division; Office, Comptroller of the Army, "Supply Program No. 10," 3, in Office, Comptroller of the Army, FY 1952 Review of Army Programs [August 1952], black binder labeled FY 52 Review of Army Programs, box 11, entry 4, RG 319.

182. Encl. 5 (Outline of Problems Making It Difficult to Obligate Funds Expeditiously) to staff summary sheet, Lt. Gen. T. B. Larkin, Assistant Chief of Staff, G–4, for the Under Secretary of the Army, 14 March 1952, sub: Obligation of Funds, folder 400.12, box 765, entry 2, RG 319.

183. Encl. (Production Information and Obligation Rates) to staff summary sheet, Christmas for Under Secretary of the Army, 9 November 1951.

184. Tab A (G–4 Views Regarding Recommendations Contained in "A Survey of Army Procurement" prepared by Arthur D. Little, Inc.) to memo, Lt. Gen. T. B. Larkin, Assistant Chief of Staff, G–4, for the Vice Chief of Staff, 22 September 1952, sub: Survey Reports on Army Procurement, ibid.

185. Tab C (Summary of Implementing Actions on Personnel and Training) to memo, Harold Pearson, Deputy Under Secretary of the Army, for the Secretary of Defense, 2 December 1952, sub: Monthly Progress Report, Basic Regulations for the Military Supply System, folder 400, cases 100-130, box 762, entry 2, RG 319; tab A (Discussion, Personnel Policies Concerning Assignment, Rotation and Career Programs Outlining Career Patterns for Military Personnel in the Supply and Procurement Areas) to memo, Col. Frank C. Norvell, Executive Assistant to the Assistant Secretary of the Army (Manpower), for the Assistant Secretary of Defense (Manpower and Personnel), 24 April 1953, sub: Information Required by Paragraph III I.1., Directive 4000.8, folder 400, cases 26-40, box 826, entry 2, RG 319; and encl. (Progress Report), 8, to memo, John Slezak, Acting Secretary of the Army, for the Secretary of Defense, 26 January 1954, sub: Progress Report on DOD Directive No. 4000.8, folder 400, cases 41-up, ibid.

186. Mobilization Analysis Center, Harvard Graduate School of Business Administration, "Requirements Planning: A Survey for the Secretary of the Army," August 1951, 2, box 10, entry 4, RG 319. For other assessments see, tab A (G–4 Views Regarding Recommendations Contained in "A Survey of Army Procurement," prepared by Arthur D. Little, Inc.) to memo, Larkin for the Vice Chief of Staff, 22 September 1952; and atch to memo, William F. Schaub, Bureau of the Budget, for the Secretary of Defense, 2 October 1952, folder Schaub Study, box 3, entry 29, RG 335.

187. "Statement of Mr. Alexander before the Intergovernmental Relations Subcommittee of the House Committee on Expenditures in the Executive Departments in connection with House Report No. 658, Federal Supply Management," [July 1951], 3, folder 334, MB Delineation, box 135, entry 26, RG 335; and Presentation to Secretary of the Army Pace (Pt. III, Materiel Requirements by Procurement Division, G–4), 26 July 1951.

188. Memo, Archibald S. Alexander, Acting Secretary of the Army, for the Secretary of Defense, 30 November 1951, sub: Controlled Materials Plan—Armed Forces Policy Council Meeting, 23 October 1951, folder 400, cases 59-99, box 762, entry 2, RG 319.

189. Hewes, *Root to McNamara*, 278-80.
190. Ordnance Corps pamphlet, *Procurement and Production: Program, Policies and Procedures, FY 1953*, November 1952, 9. See also, Presentation to Secretary of the Army Pace (Pt. III, Materiel Requirements by Procurement Division, G–4), 26 July 1951; and Press Release No. 242-52S (Fact Sheet, 1952 Procurement Report), Office of Public Information, Department of Defense, 19 December 1952, folder Procurement, 1948–1952, box 955, Subject Files, OSD/HO.
191. Presentation to Secretary of the Army Pace (Pt. III, Materiel Requirements by Procurement Division, G–4), 26 July 1951; memo, Alexander [for Secretary of the Army Frank Pace, Jr.] for the Deputy Secretary of Defense, 1 August 1951; staff summary sheet, Brig. Gen. Wayne R. Allen, Assistant Chief, Procurement Division, G–4, for Office, Under Secretary of the Army, 6 November 1951, folder 400, cases 59-99, box 762, entry 2, RG 319; encl. (Production Information and Obligation Rates) to staff summary sheet, Christmas for the Under Secretary of the Army, 9 November 1951; and memorandum for record [of meeting in the Office of the Chief of Staff], Lt. Col. James R. Cross, Assistant Secretary, General Staff, 20 November 1951, sub: Procurement Obligations and Deliveries, ibid.
192. Press Release No. 242-52S (Fact Sheet, 1952 Procurement Report), 19 December 1952.
193. Presentation to Secretary of the Army Pace (Pt. III, Materiel Requirements by Procurement Division, G–4), 26 July 1951. For an extensive report on tank production problems, see tab (Report to the House Armed Services Committee on the Army Tank Program) to encl., staff summary sheet, Maj. Gen. W. O. Reeder, Deputy Assistant Chief of Staff, G–4, for Office, Under Secretary of the Army, 19 December 1951, sub: Report to the House Armed Services Committee on Defense Production, 1-2, folder 470.8, cases 36-up, box 774, entry 2, RG 319.
194. Ibid.; memo, Alexander [for Secretary of the Army Frank Pace, Jr.] for the Deputy Secretary of Defense, 1 August 1951; tab B (Major Factors Causing Equipment Shortages) to memo, Jenkins for the Chief of Staff (Attn: General Taylor), 17 October 1951; and ltr, Reber to Honorable Carl Vinson, 21 April 1952 (quotation).
195. Memo, Lt. Gen. Williston B. Palmer, Assistant Chief of Staff, G–4, for the Secretary of the Army, 2 June 1953, sub: Summary of Tank Production, Distribution, and Modernization Since the Korean Outbreak, folder 470.8, box 831, entry 2, RG 319.
196. Encl. (Summary of R&D Accomplishments in the DA FY 1951) to staff summary sheet, Col. W. C. Stanton, Chief, R&D Planning Branch, Research and Development Division, G–4, 2 September 1952, sub: Annual Report of the Assistant Secretary of the Army (R&M) for the FY 1952, folder 201-45, Orgn and Functions, 1951–1953, box 1, entry 40, RG 319.
197. Huston, *Guns and Butter*, 78, 174, 180, 182-83.
198. Encl. 2 (Why had not our tank program developed further?), 6 November 1950, to staff summary sheet, Lt. Gen. T. B. Larkin, Assistant Chief of Staff, G–4, for the Chief of Staff, 7 November 1950, sub: Questions by the Congress, folder 032.1, box 550, entry 2, RG 319; and Special Subcommittee, House of Representatives Committee on Armed Services, Report on the Army Tank Program, 25 August 1950, folder 470.8 (25 Aug 50), box 618, entry 2, RG 319.
199. Department of the Army, "The Report of Department of the Army Armored Panel," 30 June 1950. For the total number of Army tanks, see memo, Palmer for the Secretary of the Army, 2 June 1953.
200. Memo, Lt. Gen. Matthew B. Ridgway, Deputy Chief of Staff for Administration, for Chief, Army Field Forces, 13 July 1950, sub: Tank Development and Procurement Program, folder 470.8, box 618, RG 319.
201. Memo, Palmer for the Secretary of the Army, 2 June 1953; and Assistant Secretary of Defense (Supply & Logistics), *Munitions Production Report*, 21 August 1953, 80-83, folder Munitions Production Reports, box 87, entry 220, RG 330.
202. Final Draft of presentation by Colonel Thorlin, Chief, Automotive Branch, Industrial Division; Office, Chief of Ordnance, 25 September 1951, for the Preparedness Subcommittee of the Senate Armed Services Committee, scheduled for 26 September 1951, atch to Opening Statement by Brig. Gen. E. L. Cummings, Chief, Industrial Division; Office, Chief of

Ordnance, folder 470.8, cases 7-20, box 774, entry 2, RG 319; Army Field Forces Board No. 2, "Tank, 76-mm. Gun, T41E1 (Outline Remarks, Presentation of 76-mm. Gun Tank, T41E1, to Chief of Staff, United States Army)," 30 November 1951, folder 470.8, case 37, box 775, entry 2, RG 319; tab (Report to the House Armed Services Committee on the Army Tank Program) to encl. to staff summary sheet, Reeder for Office, Under Secretary of the Army, 19 December 1951, 1-2; and Assistant Secretary of Defense (Supply & Logistics), *Munitions Production Report*, 21 August 1953, 83.

203. Staff summary sheet, Lt. Gen. W. B. Palmer, Assistant Chief of Staff, G–4, for the Chief of Staff, 19 May 1953, sub: Light Tank Family, folder 470.8, box 830, entry 2, RG 319.

204. Ltr, Gen. John R. Hodge, Chief, Army Field Forces, to Gen. J. Lawton Collins, 7 May 1953, ibid.

205. Final Draft of presentation by Thorlin for the Preparedness Subcommittee of the Senate Armed Services Committee, scheduled for 26 September 1951, 25 September 1951; Army Field Forces Board No. 2, "Tank, 90-mm. Gun, M47 (Outline Remarks, Presentation of 90-mm. Gun Tank, M47, to Chief of Staff, United States Army)," 30 November 1951, folder 470.8, case 37, box 775, entry 2, RG 319; tab (Report to the House Armed Services Committee on the Army Tank Program) to encl. to staff summary sheet, Reeder for Office, Under Secretary of the Army, 19 December 1951, 1-3; Assistant Secretary of Defense (Supply & Logistics), *Munitions Production Report*, 21 August 1953, 80; memo, Brig. Gen. K. F. Hertford, Deputy Assistant Chief of Staff for Research and Development, G–4, for the Assistant Chief of Staff, G–4, 24 November 1953, sub: Final Drive Failures in M47 Tank, folder 470.8, box 831, entry 2, RG 319; and Huston, *Guns and Butter*, 177.

206. Tab A (T48 Tank) to memo, G–4 for the Chief of Staff (Attn: Deputy Chief of Staff for Operations and Administration), [January 1953], sub: Report of Status of Development, folder 400, cases 1-25, box 826, entry 2, RG 319; and Robert S. Cameron, "American Tank Development During the Cold War: Maintaining the Edge or Just Getting By?," 2-3, unpublished manuscript prepared for the Directorate of Force Development, U.S. Army Armor Center, Fort Knox, Ky., n.d. [ca. 2002].

207. Cameron, "American Tank Development," 2.

208. Ltr, Brig. Gen. John C. MacDonald, Commander, Armored Combat Training Center, to Gen. John R. Hodge, Chief, Army Field Forces, 28 August 1952, folder 470. 8, cases 36-up, box 774, entry 2, RG 319.

209. Cameron, "American Tank Development," 2.

210. Tab A (T48 Tank) to memo, G–4 for the Chief of Staff (Attn: Deputy Chief of Staff for Operations and Administration), [January 1953], (quotation); memo, Palmer for the Secretary of the Army, 2 June 1953; and Assistant Secretary of Defense (Supply & Logistics), *Munitions Production Report*, 21 August 1953, 81. In addition to Chrysler, the Fisher Body Division of the General Motors Corporation and Ford also manufactured the M48.

211. Memo, Archibald S. Alexander, Under Secretary of the Army, for Mr. Pace, 14 August 1951, sub: Army Tank Programs, folder 470.8, cases 1-6, box 774, entry 2, RG 319; tab (Report to the House Armed Services Committee on the Army Tank Program) to encl. to staff summary sheet, Reeder for Office, Under Secretary of the Army, 19 December 1951, 4; Cameron, "American Tank Development," 4; and Huston, *Guns and Butter*, 178. For Marine Corps adoption and employment of the M103, see Estes, *Marines under Armor*, 150-53, 158, 160-62, 164-65, 171, 174.

212. Encl. to ltr, Monaghan to Honorable Homer Ferguson, 10 June 1953. The 12,251 figure includes M46 Pershings purchased prior to July 1950.

213. Memorandum for record, Lt. Col. Henry A. Rasmussen, Office, Chief Procurement Division, G–4, 24 July 1952, sub: Conference with Field Forces Representatives on Processing of Engineering Change Orders, 21 July 1952, folder 400, cases 131-up, box 762, entry 2, RG 319.

214. Memo, Robert T. Stevens, Secretary of the Army, for the Secretary of Defense, 3 July 1953,

sub: Light Tanks, folder CD 470.8, box 41, entry 199, RG 330.
215. Staff summary sheet, Maj. Gen. Carter B. Magruder, Deputy Assistant Chief of Staff, G–4, for Office, Under Secretary of the Army, 28 January 1953, sub: Production Schedule for Tank, Light Gun, T41E1, folder 470.8, cases 1-6, box 774, entry 2, RG 319; and encl. to ltr, Monaghan to Honorable Homer Ferguson, 10 June 1953.
216. Tab A (memo, Maj. Gen. Reuben E. Jenkins, Assistant Chief of Staff, G–3 for Lt. Gen. Maxwell D. Taylor, Deputy Chief of Staff for Operations and Administration, 24 September 1951) to staff summary sheet, Maj. Gen. Reuben E. Jenkins, for the Chief of Staff, 4 October 1951, sub: Availability of Tanks to EUCOM, folder 323.3, Arsenal-Ordnance Works, box 717, entry 2, RG 319; and final draft of presentation by Thorlin for the Preparedness Subcommittee of the Senate Armed Services Committee, scheduled for 26 September 1951, 25 September 1951.
217. Ltr, Headquarters, United States Army Europe, to The Adjutant General (Attn: Assistant Chief of Staff, G–4), 28 October 1953, sub: M47 Tank Deficiencies; and memo, Hertford for the Assistant Chief of Staff, G–4, 24 November 1953: both in folder 470.8, box 831, entry 2, RG 319.
218. Ltr, Lt. Gen. A. C. McAuliffe, Commanding General, Seventh Army, to Gen. Matthew B. Ridgway, 5 November 1953, ibid.
219. Ltr, Gen. Matthew B. Ridgway, to Lt. Gen. A. C. McAuliffe, 27 November 1953, ibid.
220. Tab E (Comment #2 from Chief of Ordnance, 21 August 1952) to staff summary sheet, Maj. Gen. John K. Christmas, Chief, Procurement Division, G–4, for the Chief of Staff, 17 September 1952, sub: Processing of Engineering Change Orders, folder 400, cases 131-up, box 762, entry 2, RG 319.
221. Memorandum for record [of meeting in the office of the acting deputy chief of staff for operations and administration, 18 August 1952], Col. W. S. Triplet, Chief, Development Branch, Research and Development Division, G–4, 20 August 1952, sub: The Pros and Cons of Telescoping the Development, Testing and Procurement of BAT and Ontos, folder 470.8, box 831, entry 2, RG 319.
222. Tab A (Memorandum for record [of meeting on light gun tank, T41, in the office of the chief of staff, 2 July 1952], Lt. Col. James C. Cross, Assistant Secretary, General Staff, 3 July 1952) to staff summary sheet, Maj. Gen. W. O. Reeder, Deputy Assistant Chief of Staff, G–4, for the Chief of Staff, 11 August 1952, sub: Light Gun Tank, T41E1; staff summary sheet, Maj. Gen. C. D. Eddleman, Assistant Chief of Staff, G–3, for the Chief of Staff, 28 October 1952, sub: Evaluation of the 76-mm. Gun Tank, T41E1; and memorandum for record [of demonstration and discussion at Aberdeen Proving Ground, 30 October 1952], Lt. Col. James C. Cross, Assistant Secretary, General Staff, 3 November 1952, sub: Demonstration and Discussion of Armored Vehicles: all in folder 470.8, cases 1-6, box 774, entry 2, RG 319.
223. Memo, Maj. Gen. K. D. Nichols, Chief of Research and Development, Office of the Chief of Staff, for General Taylor [Lt. Gen. Maxwell D. Taylor, deputy chief of staff for operations and administration], General Bolté [Lt. Gen. Charles L. Bolte, deputy chief of staff for plans and research], 2 May 1952, sub: Medium Tank Program, folder 470.8, cases 36-up, box 774, entry 2, RG 319; and tab A (Ltr, Maj. Gen. I. D. White to Gen. J. Lawton Collins, 10 May 1952) to staff summary sheet, Maj. Gen. Reuben E. Jenkins, Assistant Chief of Staff, G–3, for the Chief of Staff, 27 June 1952, sub: Gen. I. D. White's Visit to the Tank Arsenal at Detroit, folder 470.8, case 37, box 775, entry 2, RG 319. Maj. Gen. I. D. White commanded the Armored Center at Fort Knox and was Collins' special advisor on tank development issues.
224. Materiel Requirements Review Committee, Lead Time Study, August 1961, 17, folder Background Material, MRRC, box 25, entry 21 (Office of the Secretary of the Army; Records of the Hoelscher Committee, Study Groups, 1961–1962), RG 335.

I. See Defense Acquisition University, *Glossary of Defense Acquisition Acronyms and Terms*, 13th ed., B-102, B-189.

II. See Coakley, Kugler, and Demma, "Historical Summary of the Evolution of U.S. Army Test and Evaluation System," 1-6.

III. See Department of the Army, "The Report of Department of the Army Armored Panel," 30 June 1950, app. 14, 119-20.

IV. Sources: Philip Shiman, *Forging the Sword: Defense Production During the Cold War*, USACERL Special Report 97/77, 6, 11, 30, 41, 138-39; Randy Talbot, *Giving Them the Very Best: Story of the TACOM Life Cycle Management Command*, 2-8; Harry C. Thomson and Linda Mayo, *The Ordnance Department: Procurement and Supply*, United States Army in World War II, 227-30, 242; and Kevin Thornton and Dale Prentiss, *Tanks and Industry: The Detroit Arsenal*, 1940–1954, 3, 7, 13-17, 21-25, 29-30, 35, 54-56, 59-64.

CHAPTER V

Emergence of the Weapon System Concept: The Air Force and Acquisition, 1945–1953

World War II ended on the deck of a battleship, USS *Missouri*, in Tokyo Bay on 2 September 1945. Some believed, particularly air power partisans, that the atomic bomb and long-range aircraft had already made such vessels virtual museum pieces, even that armies and navies were now obsolete. But leaders of the Army Air Forces, the only military branch then capable of delivering the new explosive, knew their service also faced an uncertain future. Three weeks after the Japanese surrender, at a Pentagon meeting attended by representatives of the industrial firms that had produced the huge and powerful U.S. air arm during the war, AAF officials offered a glimpse of what might lie ahead. Assistant Secretary of War for Air Robert Lovett explained that much about the future defense setup was unknown, but he anticipated that the military departments would have to compete for funds, justify their existence, deal intelligently with newly developed weapons, and above all, work together with industry in the future as they had in the past. In this latter respect, he asserted, the Army Air Forces would be "absolutely dependent" on a healthy aircraft industry.[1]

General H. H. ("Hap") Arnold, the AAF's commanding officer, also emphasized the importance of their industry to the assembled executives. But he was not optimistic that the Army Air Forces would be able to continue purchasing large numbers of aircraft and engines over the next few years, given the public's apparent desire to reduce government expenditures. In fact, the Army Air Forces planned to buy no more than 1,046 aircraft during 1946. This news, while not unexpected, must have had a chilling effect on Arnold's audience, such men as J. H. "Dutch" Kindelberger, president of North American Aviation, which built more than 40,000 aircraft during the war, and Guy W. Vaughan, head of the Curtiss-Wright Corporation, the single biggest wartime producer of piston engines, nearly 140,000 of the total of 800,000 manufactured. Arnold did offer one ray of hope to the manufacturers; he thought that funds for research and development would not be cut back as sharply as those for procurement and that the aircraft industry, working in concert with the military and with the scientific community, would together be able to create a technologically advanced air force for the future.[2]

Arnold and other AAF leaders, like their successors in the U.S. Air Force, were firmly convinced that only air forces, equipped with the latest weapons, would be able to preserve the nation's security. By the late 1940s, other American leaders were in agreement—a technologically superior Air Force armed with nuclear weapons and always ready to go to war had become the cornerstone of U.S. security policy and strategy. But creating an air arm on technology's cutting edge—the "Air Force of the Future"—and one also able to respond immediately and effectively—the "Air Force-in-Being"—often imposed conflicting demands on the service's materiel component. Advanced technology was essential to mission success, but deploying it prematurely might endanger the mission. The Air Force, seeking to achieve both of these objectives, worked to develop internal organizational structures and management methods suited to an acquisition process made increasingly complicated by the pace of technological change.

THE AIR FORCE, 1945–1953: AN OVERVIEW

From the end of World War II through the Korean War, the Air Force's position within the military establishment underwent a rapid transformation. In September 1945, the Army Air Forces was but one of the Army's three main organizational elements that also included the Army Ground Forces and the Army Service Forces. Two years later, the Army Air Forces separated from the Army to become an independent military service, the U.S. Air Force, coequal with its parent and with the Navy. Soon, the Air Force achieved preeminence among the three, supplanting the Navy as the nation's first line of defense.[3] Confirmation of Air Force ascendancy came in the fall of 1951. The Joint Chiefs of Staff, in their FY 1953 budget proposal, recommended that funding for the Army and Navy increase only slightly but that the Air Force should expand to 143 combat wings from the 95 authorized less than a year earlier. The secretary of defense, the president, and Congress endorsed this recommendation, approving \$20.6 billion in appropriations for the Air Force but only \$13.2 billion for the Army and \$12.6 billion for the Navy. These funding levels marked the end of the "balanced forces" concept of budget parity among the services that had generally prevailed since the end of World War II.[4]

The Air Force's rise to become the nation's dominant military arm was a consequence of forces and developments that also shaped its acquisition structure, processes, and programs. The most important of these influences were sharp fluctuations in defense spending, the primacy of the strategic air offensive in U.S. national security strategy, and the impact of onrushing technological change.

The chaotic demobilization following World War II affected the Army Air Forces as severely as it did the other services. On V-J Day in 1945, it totaled 218 combat groups and 2,253,000 uniformed personnel. By the end of 1946, the number of combat groups was down to 55.[5] That was paper strength only. In terms of combat readiness, the picture was much worse. In fact, in January 1947, Lt. Gen. Ira C. Eaker, deputy AAF commander, asserted at the Industrial College of the Armed Forces that less than a year after the war ended, the Army Air Forces "did not have left a single group of acceptable combat efficiency anywhere. We did not have a single squadron that we would have been satisfied to put into combat."[6]

From this low point, the Air Force sought to rebuild toward the 70 combat groups (redesignated "wings" in the late 1940s) that the War Department and the JCS had approved early in 1946 as its postwar force-structure goal.[7] Low levels of military spending in the late 1940s, however, prevented the desired expansion. In May 1948, in response to the tense international situation earlier in the year and vigorous industry lobbying, Congress appropriated over $3 billion for Air Force and Navy aviation procurement for FY 1949. President Truman signed the legislation, but, desiring to hold down spending, refused to authorize expenditure of the $822 million that Congress had added to the administration's budget request as a tangible endorsement of the 70-group Air Force recommended by the president's own Air Policy (Finletter) Commission in January 1948 (see chap. 2). If all $3 billion had been available, it would have funded a gradual increase in Air Force combat wings, although the administration's budgets for the service for FY 1950 and FY 1951 would not have sustained the growth. Therefore, the number of Air Force wings stayed at 48 prior to the Korean War, far short of the ultimate 70-wing objective.[8]

After mid-1950, the budget screws loosened in response to the Korean War and the increased force levels approved for NSC 68 later in the year. The Air Force's funding escalated sharply. From the $4.75 billion originally proposed by the administration for FY 1951, the Air Force's budget expanded to $15.98 billion that year, and to $22.26 billion in FY 1952. It fell back, although not nearly as far as that of the other two services, to $20.58 billion in FY 1953.[9] In FY 1951, projected force levels also rose with each budget increase. From 48 wings on the books in June 1950, the JCS recommended and the administration approved an expansion to 58 wings in July, to 78 in September, and to 95 in December—the latter to be achieved by June 1952.[10] In October 1951, less than a year after the 95-wing structure had been authorized, the JCS established the 143-wing target for June 1953.[11]

AIR FORCE ACTIVE FORCES
FY 1947–FY 1953

FY	1947	1948	1949	1950	1951	1952	1953
Groups/Wings	38	55	59	48	87	95	106 ⅔
Personnel [1]	306	388	419	411	788	983	978

1. Personnel figures (in thousands).

The Truman administration's lean military budgets may have held back Air Force expansion before the Korean War, but since they also limited the size of the Army and Navy, they drove the White House toward adopting a national security strategy based on a nuclear air offensive carried out by the Air Force. After World War II, defense officials agreed that the next war, much like the last, would begin suddenly and quickly become a total war. In this conflict, both sides would employ even more advanced and powerful versions of the long-range bombers, primitive jets, guided missiles, and atomic bombs first used in the war just ended. There would be little or no time to mobilize forces; the oceans would no longer be effective barriers. The nation would have to fight with the weapons on hand.[12] In these circumstances, Air Force leaders repeatedly emphasized that a strong "Air Force-in-Being," equipped with nuclear weapons and able to respond immediately, would be the best hope for deterring an aggressor and avoiding war. Should deterrence fail, this powerful force would be the best means of defending the United States and launching a prompt retaliatory offensive against the aggressor's capacity to wage war.[13]

The strategic air offensive had deep roots in the Air Force's history. The idea that aerial attacks by unescorted but heavily armed bombers on key targets in an opponent's industrial infrastructure could decide the outcome of war had enabled airmen to define a separate identity prior to World War II. But the results of the AAF's execution of that concept during the war were at best ambiguous. Nations subjected to massive air attack proved more resilient than partisans of strategic bombing believed they would be. Furthermore, contrary to the airmen's prewar assumption, the bomber was not able to penetrate well-defended targets effectively without accompanying fighter escorts. After the war, however, evidence of the atomic bomb's destructive power tended to shore up strategic bombardment theory and give it new life. But rather than seeking a less vulnerable delivery vehicle, such as ballistic missiles, the Air Force sought to increase the bomber's survivability by continually enhancing its performance with respect to range, speed, altitude, defensive armament, and weapon delivery accuracy.[14]

Despite its doctrinal significance, the strategic air offensive did not immediately enjoy unquestioned supremacy within the Air Force. Other missions, such as air defense and tactical air, competed for resources and importance. But, by the end of 1948, airmen had largely accepted the strategic air offensive's top priority within their service.[15] In December, the creation of the overarching Continental

Air Command to control the assets of both the Air Defense Command and the Tactical Air Command clearly reflected the lesser status of air defense and tactical aviation (the latter including the commitment to provide close air support to the Army).[16] Although the USSR's detonation of an atomic bomb in August 1949 caused heightened concern over the U.S. capability to detect and to intercept Soviet bombers, General Muir S. Fairchild, vice chief of staff, disapproved a headquarters staff (the Air Staff) recommendation to give air defense programs equal priority to strategic bombing programs.[17] Similarly, when the Korean War put the spotlight on tactical aviation, the Air Force separated the Tactical Air Command from the Continental Air Command, but did not develop specialized aircraft tailored for close air support or night interdiction.[18]

By the time the Korean War broke out in mid-1950, budget imperatives and the arguments of the Air Force's leadership had won the day. An air offensive, to be executed almost entirely by Air Force bombers delivering nuclear weapons on Soviet industrial targets, had become the central feature of U.S. military strategy.[19] To many, both in and out of government, a nuclear air offensive appeared to be the cheapest and the most effective method for countering the perceived Soviet numerical advantage in men and materiel.[20] Large, conventional forces would be expensive; the atomic bomb's enormous destructive power and its exclusive possession by the United States until the summer of 1949 seemed to make them unnecessary. Army and Navy leaders, denied funds for the conventional forces they believed essential, had no other viable alternative to recommend. As a result, those two services were left with secondary defense roles. (The Navy's flush-deck supercarrier had been cancelled early in 1949, and the Navy's campaign against the Air Force's long-range, B–36 heavy bomber failed later in the year.)[21]

B–29 Superfortress (left), largest bomber of World War II, alongside XB–36 Peacemaker.
Courtesy, National Museum of the U.S. Air Force.

The atomic bomb and long-range aircraft made the strategic air offensive a credible strategy. The Air Force sought to maintain superiority in these and a wide range of advanced technologies to ensure both the offensive's viability and the service's future strength. That effort largely determined the course of Air Force acquisition.

Nuclear explosives, the most militarily significant technology produced during World War II, affected Air Force programs in numerous ways. First-generation atomic bombs were big and heavy, weighing approximately 5 tons.[22] The first hydrogen device, tested in the western Pacific on 1 November 1952 weighed 82 tons; the first air-deliverable hydrogen bomb, later designated the Mark 17, weighed about 21 tons and was successfully tested in the spring of 1954, also in the western Pacific.[23] Smaller and lighter bombs, weighing less than 3,000 pounds, became available by the early 1950s, but the large, long-range bomber would be the only practical nuclear weapons carrier through the end of the Korean War.[24]

Not only did nuclear-armed bombers have to be big, but they were also needed in large numbers. The atomic stockpile, constrained by the availability of fissionable material, had grown slowly after 1945. Only 9 bombs existed in July 1946; just 13 in June 1947.[25] Late in 1947, the Air Force estimated that 200 atomic bombs would be required to execute the planned strategic air offensive.[26] By mid-1948, however, the stockpile was about 50 and did not exceed 200 until 1949–1950.[27] Thus, any time before 1949, a strategic air attack employing atomic bombs against Soviet targets also would have required many bombers carrying conventional munitions. But even achieving a supply of atomic bombs sufficient for the desired target coverage would not have defined the upper limit of the bomber force. To increase the likelihood that aircraft carrying nuclear weapons would actually reach their targets, the Strategic Air Command (SAC), formed in 1946 to carry out strategic air operations, planned to employ some nonnuclear-armed bombers as defensive escorts, others to attack enemy air defenses, and still others in a diversionary role.[28] Additionally, despite the centrality of nuclear weapons to the strategic air offensive, the JCS—including General Hoyt Vandenberg, the Air Force chief of staff—did not think the Soviets would succumb to an immediate, all-out nuclear attack.[29] In other words, the JCS believed war would go on for sometime, requiring repeated strikes by conventional as well as nuclear-armed bombers.

For the Air Force then, the atomic bomb put a premium on the development of heavy bombers in substantial quantities. But another technological advance, the advent of smaller and lighter nuclear weapons in the early 1950s, increased the importance of other Air Force weapon systems such as guided missiles and tactical aircraft. In 1950, although concerned that alternative delivery systems not cut into the supply of nuclear weapons available for the strategic air offensive, the Air Force, following a decision by the secretary of defense, began to adapt two "air-breathing" or "cruise" missile systems then under development as nuclear weapons carriers, the surface-to-surface Snark and the air-to-surface Rascal.[30] In 1951, the Air Force introduced a nuclear weapons capability into tactical aircraft already in production, the B–45 bomber and the F–84G fighter-bomber. Some of these nuclear weapons–capable aircraft deployed to England in 1952 to form part of the NATO forces that would oppose a Soviet attack on Western Europe.[31]

General Henry H. ("Hap") Arnold, commanding general, Army Air Forces, 1941–1946.
Courtesy, National Museum of the U.S. Air Force.

Along with nuclear explosives, the use of the guided missile during World War II heralded dramatic changes in future warfare. Applied by the Germans in a strategic role, the new technology represented a potential competitor for the bomber. In fact, some Air Force leaders suggested that such "pilotless aircraft" might replace manned aircraft entirely. For example, at the meeting with the aircraft manufacturers in September 1945, General Arnold had stated that "it looks to me as if sometime—10 years from now, 15 years from now—we will have rockets maybe that home on heat, light, metal, what have you, to be used in place of fighter planes." He also told the industrialists that "we will have rockets with wings on them that will be able to go much farther and be able to hit the target with greater accuracy than the V–2 could have done."[32]

In keeping with Arnold's vision, the Air Force planned an aggressive postwar missile development program. Under way in the spring of 1946 were 28 projects of four types of missiles: air-to-air, air-to-surface, surface-to-air, and surface-to-surface. Among the latter were studies of both long-range (1,500–5,000 mile) jet-propelled cruise missiles and rocket-powered ballistic missiles projected to carry 5,000-pound payloads. But budget reductions during the next several years slashed the number of these projects to 7, and on the eve of the Korean War, only 3 missiles were in full-scale development. They were the 100 to 300-mile range, bomber-launched, air-to-surface Rascal; the fighter-launched, air-to-air Falcon; and the supersonic, 5,000-mile-range Navaho cruise missile. Snark, also with a 5,000-mile-range, but subsonic, was continued although initially limited to subsystem development. The sole ballistic missile project, under contract to Convair (Consolidated-Vultee Aircraft Corporation), had fallen victim to the budget cuts and had been cancelled in mid-1947.[33]

The results of the missile program's contraction showed clearly that the Air Force had chosen bombers over missiles for executing the strategic air offensive. Indeed, two of the three missile development projects that survived the cuts, Rascal and Falcon, were designed to support the manned bomber. The third, the long-range Navaho cruise missile, had won out (for the time being) over its ultimately more deadly ballistic competitor being developed by Convair for several reasons. Cruise missiles were less expensive per copy to develop, seemed likely to become operational sooner, needed fewer technical advances, and promised better payload and range performance than ballistic missiles.[34] Even when the Air Force's missile program expanded significantly as part of the rearmament that began after mid-1950, cruise missiles were still preferred. Although the ballistic missile was less vulnerable, and smaller and lighter nuclear warheads promised to correct its payload deficiency, the prevailing view within the Air Force held that Navaho and Snark were more technically reliable. The Convair intercontinental ballistic missile (ICBM), named Atlas, had been revived as part of the budget increases associated with the Korean War and NSC 68, but unlike other missiles under development, would not be immediately accelerated.[35]

During the late 1940s and early 1950s, demonstrated technological reliability explained the Air Force's preference for manned bombers over missiles, although doctrinal heritage and pilot culture no doubt exerted some weight. In December 1952, Under Secretary of the Air Force Roswell L. Gilpatric explained the service's thinking succinctly in a memorandum to the incoming Eisenhower administration's Air Force civilian leadership: "As of the present writing, it would appear that many years will elapse before *major dependence* can be placed on these new weapons and that meanwhile another generation of piloted aircraft . . . will be needed."[36] In short, for the indefinite future, American leaders had banked the nation's security on the Air Force's ability to execute the strategic air offensive with heavy bombers. Consequently, those forces received the highest priority.

Along with nuclear warhead and guided missile technologies, jet propulsion also profoundly affected Air Force acquisition programs. The best World War II piston-engine fighters flew in the vicinity of 450 mph. Jet engines made dramatically higher speeds possible, up to and several times beyond the speed of sound (760 mph at sea level). To fully exploit jet power's potential, designers radically altered aircraft configurations as reflected in the swept-back wings on the F–86 fighter and the B–47 medium bomber; or the swept, delta-shaped wing and "coke-bottle" (indented) fuselage on the F–102 fighter interceptor.[37] Aircraft subsystems, just as airframes, had to keep pace with jet speeds. Electronically operated fire control systems, for example, substituted radar and computers for outmatched human eyes and brains to detect opposing aircraft and to direct guns, rockets, and missiles against them. After World War II, the Air Force sought to convert from piston to jet engines as quickly as it could. By mid-1954 more than 40 percent of the aircraft in its inventory and almost two-thirds of its combat units were jet-equipped.[38]

While nuclear warheads, missiles, and jet propulsion were the most important new technologies, advances occurred across the entire spectrum of military aviation and were exploited by the Air Force. Automatic ejection seats improved pilot survivability, with the first successful ejection from an Air Force jet occurring in 1949.[39] Aerial refueling technology and techniques that American aviators had experimented with in the 1920s and the British had put into practice after World War II, enhanced the bomber's utility by significantly extending its range.[40] This was especially true for jet bombers whose engines consumed fuel much more rapidly than piston-driven aircraft. The high-speed, but medium-range B–47, for example, acquired intercontinental range when refueled by the KC–97 tanker.[41] Tankers were regularly refueling SAC bombers by the end of 1949. They began to refuel fighters in 1951.[42]

The transistor, first developed by Western Electric Company's Bell Telephone Laboratories, was yet another key technological innovation destined to influence weapon system development. In late 1951, Air Force Chief Scientist David T. Griggs, in something of an understatement, wrote a colleague, then working for the RAND Corporation, about a proposal for an earth-circling satellite: "I note that your payload weight figures and reliability seem to be still tied to the use of vacuum tubes. I should think it most worthwhile to explore the possibilities of weight reduction by employing transistors. From what I have heard of their reliability, they would be infinitely better."[43] At this time, the Air Force was just beginning to investigate the transistor's application to military aviation. In fact, transistors proved to be significantly smaller, consume less power, generate less heat, and last far longer than their vacuum tube predecessors. Within a year, the Air Force had let contracts to study the use of transistors in a wide range of its systems.[44]

In summary, from 1945 to 1953, the Air Force sought to acquire the most advanced weapon systems and, at the same time, to maintain a "force-in-being" ready to carry out its missions effectively—above all, the strategic air offensive. These goals—a quality force at technology's cutting edge but also an effective force poised to strike immediately—sometimes conflicted. The evolution of the Air Force's acquisition organization and processes often reflected the competing demands generated by both objectives.

ORGANIZING TO EXPLOIT SCIENCE AND TECHNOLOGY

Even before separating from the Army in 1947, the Army Air Forces took steps to solidify the ties established with the nation's scientific and technical community during the war. By and large, through a variety of mechanisms, these efforts succeeded. Ironically, advanced technology proponents in the Air Force experienced difficulty in securing a strong position for research and development within their service's organizational structure. In fact, their campaign to create a separate R&D operating command as well as a position on the Air Staff equal in status to the other principal staff functions would generate controversy and take several years before succeeding.

Institutionalizing Ties to the Scientific and Technical Communities

Soon after World War II, the Army Air Forces set up mechanisms designed to institutionalize science and technology's place in the service. These included the Scientific Advisory Board, administered by the Air Staff, and the RAND Corporation, outside the AAF's formal organizational structure. General Arnold had laid the foundation for these arrangements in September 1944 when he asked Theodore H. von Karman, his friend and closest scientific adviser, to direct a study identifying probable advances in science and technology that could guide the service's postwar research and development. Delivered to Arnold in 1945 by the recently formed AAF Scientific Advisory Group, the numerous reports, consolidated under the title *Toward New Horizons*, predicted not only future military technologies but also recommended ways to ensure the continued partnership between airmen and scientists. One of the proposals was to make the Scientific Advisory Group a permanent body.[45]

Dr. Theodore H. von Karman, director, Army Air Forces Scientific Advisory Group, 1944–1946; chairman, Army Air Forces and U.S. Air Force Scientific Advisory Board, 1946–1954.

Renamed the Scientific Advisory Board and chaired by von Karman, the group held its inaugural session in June 1946, the first of 12 formal meetings before the end of the Korean War. Initially composed of about 30 members, mostly university and government scientists, but with some representatives from industry, the Scientific Advisory Board was supported by a general officer who served as the board's military director and liaison with the Air Staff, and by a permanent secretariat. During periodic meetings, the board and its committees reviewed aspects of the Air Force's research and development program and made recommendations directly to the chief of staff in formal reports.[46] Although not part of the Air Staff's regular decision-making process, the Scientific Advisory Board unquestionably influenced Air Force research and development policy and organization. In 1949–1950, the board was instrumental in helping to secure organizational autonomy within the Air Force for research and development, and, in late 1952, it significantly affected the Air Force's decision not to speed up its intercontinental ballistic missile program.[47]

Along with looking to von Karman's Scientific Advisory Group for advice, General Arnold turned to industry to explore the application of advanced weapons to warfare. Working with Edward L. Bowles, another of his scientific advisers, Arnold arranged with the Douglas Aircraft Company to investigate the possibility of developing an intercontinental guided missile. In March 1946, a month after Arnold retired, the Air Force contracted with Douglas for $10 million to perform the work. Called Project RAND (a contraction of research and development), it involved more than designing new hardware, also including analysis of the larger context of warfare in which intercontinental missiles might be employed. Soon RAND, headquartered in Santa Monica, California, became known for evaluating weapons as "systems"—a methodological approach called "systems analysis" that considered not only technology but also political, economic, institutional, logistic, and other factors that might influence weapons selection.[48] To strengthen the credibility of its analyses, RAND divorced itself from Douglas in late 1948 and became a nonprofit organization funded by the Air Force. At that time, it employed nearly 200 professional staff, mostly mathematicians, physical scientists, and engineers but also some philosophers, social scientists, and economists.[49]

RAND produced numerous studies for the Air Force before the end of the Korean War.[50] The two most important were the Strategic Bombing Systems Analysis, completed in 1950, and a study of the Air Force's overseas basing that was briefed to Air Force officials over the spring and summer of 1953. The strategic bombardment report was not well received, in large part because it was an abstract model of strategic air warfare and failed to address sufficiently actual problems in current operational planning. Also, RAND's recommendation that a turboprop aircraft be developed for the strategic bombing mission was out of step with the Air Force's preference for high-performance systems—for quality over quantity. Although comparable in most performance factors and much less expensive than the XB–52 design preferred by SAC, the turboprop bomber proposed by RAND could not match the speed of the jet-only Boeing XB–52.[51] The basing study, in contrast, focused on a critical operational problem—the vulnerability of bases to nuclear attack, especially overseas bases that SAC depended on to execute the strategic air offensive. As a result of the RAND analysis, the Air Force moved to reduce its reliance on overseas bases for pre-strike operations, emphasizing their role in refueling strategic bombers en route to targets and in recovering aircraft after strikes had taken place.[52]

Following the Air Force's rejection of RAND's strategic bombing systems study, some analysts within the corporation's economics department, particularly Armen A. Alchian, began to question whether the methodologies employed in "systems analysis" were adequate tools for addressing issues associated with rapidly advancing technology, particularly its inherent uncertainty. There were, in short, too many variables. In response, practitioners of systems analysis at RAND applied their techniques to more narrowly focused problems. While continuing to critique systems analysis, Alchian and others at RAND turned their attention to the larger issue of how R&D was managed. Their investigations would lead them to challenge the "weapon system approach" that the Air Force adopted at the end of 1952 for the acquisition of its major weapon systems.[53]

A False Start for Research and Development

While RAND and the Scientific Advisory Board had close ties to the Air Staff and influenced policy, neither was part of the Air Force's formal acquisition structure. In 1945, both von Karman and Bowles sought to ensure that research and development would enjoy a powerful position in the postwar Air Force's organizational hierarchy. In *Toward New Horizons*, von Karman recommended that research and development be managed by a special Air Staff section or directly by the Office of the Chief of Staff.[54] Bowles suggested that a position for directing research and development be established on the Air Staff. It would rank above the other major functional staff elements such as personnel, intelligence, operations, and materiel.[55] Organizational changes of the kind the two scientists proposed would not only give science and technology more institutional prestige, but would also free research and development from what many believed had been its subordination to production and procurement during World War II.[56]

In December 1945, on the advice of von Karman and Bowles, Arnold created the position of deputy chief of air staff for research and development. Its first and (as it turned out) only occupant was Maj. Gen. Curtis LeMay. His appointment was likely influenced by the recommendation of a board headed by General Carl A. Spaatz, who would soon succeed Arnold as the AAF's commander and, in September 1947, would become the first Air Force chief of staff. The board had been formed to consider the likely effects of the atomic bomb on strategy, organization, and force structure. Its October 1945 report called for "an officer of the caliber of Maj. Gen. Curtis E. LeMay" to be named to the post.[57] One of the service's brightest stars, LeMay had distinguished himself leading B–17 operations over Europe and directing the B–29 bombardment of Japan. He also possessed some technical credentials—a bachelor's degree in civil engineering from Ohio State University and completion of the Air Corps engineering course at Wright Field before the war. One scholar has suggested that LeMay was chosen for the job primarily because AAF leaders believed that the blunt and aggressive combat leader would be able to assert the service's vital interest in military nuclear development, then still under the firm control of Maj. Gen. Leslie R. Groves, an Army officer and head of the wartime Manhattan Project.[58] In the new position, LeMay's authority was limited to coordinating the AAF's research and development program, not supervising its execution. That responsibility belonged to the assistant chiefs of staff who headed the major Air Staff functional elements, particularly the assistant chief of staff for materiel, who oversaw the Air Materiel Command, which performed most of the service's research and development activities and was located at Wright Field (renamed Wright-Patterson Air Force Base in 1948). Despite its auspicious beginning, the post of deputy chief of air staff for research and development had a short life. In October 1947, soon after the Air Force became independent, it was abolished and its function on the Air Staff assigned to the deputy chief of staff for materiel.[59]

This organizational downgrading of research and development paralleled a similar action taken by the Army for its headquarters setup. In December 1947, as described in chapter 4, the Army dissolved the General Staff's Research and Development Division and subordinated it to the Service, Supply, and Procurement Division, the equivalent of the Air Staff's deputy chief of staff for materiel. As in the Army's case, a number of factors influenced the Air Force's reorganization.

Headquarters building, Air Materiel Command, Area A, Wright-Patterson Air Force Base, Ohio, ca. 1953.

Some of the reasons for the change appeared to be related to the need for bureaucratic efficiency. In mid-1947, an unsigned "eyes only" memorandum for General Spaatz warned that the Air Force would likely lose out to the other services on issues involving interdepartmental coordination unless a single officer at headquarters controlled all aspects of materiel: "I agreed in the theory of an R&D man on the staff, but do not now think it will work. There are too many people with their fingers in the broth of this problem especially as today it is almost impossible to segregate R&D from procurement; and vice versa; and consequently we create a misty picture to the other Services and to the outside. There should be one boss. . . ."[60] Assigning the duties of the deputy chief of air staff for research and development to the deputy chief of staff for materiel was a step in that direction. In June 1948, in his public report on the service to Secretary of the Air Force W. Stuart Symington, Spaatz offered a closely related rationale for the reorganization, explaining that the research and development position had been eliminated in part to reduce the number of staff elements reporting directly to the chief of staff.[61] A year later, General Vandenberg, who succeeded Spaatz, suggested to the Scientific Advisory Board yet another organizational motive for the change: A deputy chief of air staff for research and development had not worked out because it was isolated from the other staff elements, making it difficult to coordinate the service's diverse research and development program.[62]

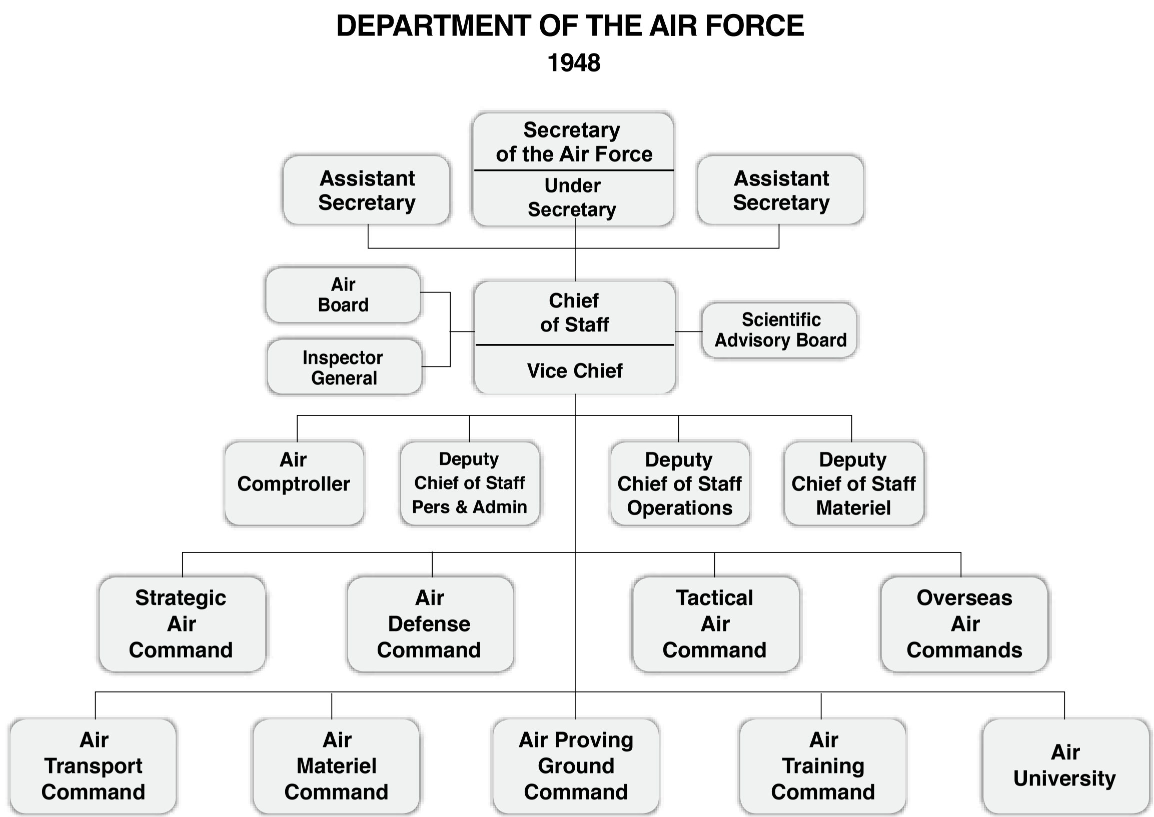
In addition to organizational effectiveness, another reason for depriving research and development of its independence on the Air Staff was a belief that emphasis on acquiring advanced technology had caused production and procurement to be slighted. The author of the mid-1947 "eyes only" memorandum to Spaatz complained that the Air Force assigned six general officers to research and development but none to planning for industrial mobilization, thus lessening attention on designing systems that could be produced quickly and in large numbers. Furthermore, at the Air Materiel Command, the division with responsibility for procurement was headed by only a colonel.[63] In short, it seemed to some that providing for the "Air Force of the Future" had become more important than ensuring the effectiveness of the "Air Force-in-Being."

In mid-1948, Secretary of the Air Force Symington made the service's priority clear in his first report to the secretary of defense. Research and development was vital, but not at the expense of meeting current mission requirements. The service, he stated, must promote technical improvements "without impairing or obscuring the requirement for an 'Air Force-in-Being' made up of production aircraft and equipment now available."[64] Thus, in the newly independent Air Force, just as in the Army, those who believed that acquisition management should not be divided and should be controlled by the traditional organizational structure had effected what amounted to a coup. But in the Air Force, their triumph was to be relatively short lived. Proponents of greater importance for research and development were hard at work seeking to have its organizational subordination to production and procurement reversed.

Creation of the Air Research and Development Command

In 1948, not long after the Air Staff reorganization that placed research and development under materiel, some Air Force officers and scientists from the academic community and industry associated with the service began to urge that research and development once again be separated organizationally from production and procurement and that the function receive an infusion of resources. In early 1950, through skillful political action, they achieved their organizational goal. Also, by the end of that year, the flood of funds resulting from the Korean War and subsequent approval of NSC 68's force objectives enabled the Air Force to pour much more money into research and development.[65]

Both senior and relatively junior officers comprised the group pushing for research and development to attain greater influence in Air Force decision making. Two generals were its informal leaders: Brig. Gen. Donald L. Putt, who, in 1948, was the director of research and development in the Office of the Deputy Chief of Staff for Material on the Air Staff, and retired Lt. Gen. James H. ("Jimmy") Doolittle, who led the famous attack by B–25 bombers on Tokyo in 1942 and commanded three air forces during the war. Putt held a master of science degree in aeronautical engineering from the California Institute of Technology and had spent most of his career in acquisition-related assignments. After retiring as a lieutenant general, Doolittle became a vice president and later director of the Shell Oil Company. During his military career, he had acquired considerable experience in aircraft development, especially testing. His academic credentials were exceptional. In 1924, he earned a doctorate in aeronautics from the Massachusetts Institute of Technology—at that time not only one of the small number of officers in the air arm with a doctorate, but also among the few people in the country holding a doctorate in that field.[66]



Source: Adapted from Plate 1 (Organization of the Air Staff) and Plate 2 (Organization of the U.S. Air Force), in *The Air Officer's Guide*, 42, 43.

Lt. Gen. Donald L. Putt
Courtesy, U.S. Air Force.

Lieutenant General Donald L. Putt (1905–1988)

From 1948 to 1958, Lt. Gen. Donald Putt held the top R&D jobs in the U.S. Air Force. In these posts, he did more than any other uniformed officer during this period to ensure that his service would be the most technologically advanced air force in the world.

Born in Sugarcreek, Ohio, in 1905, Putt demonstrated an early interest in new technologies, working as a wireless operator on a freighter on the Great Lakes in the year following his graduation from high school. In 1928, he earned a bachelor's degree in electrical engineering from the Carnegie Institute of Technology in Pittsburgh and entered flying training in Texas, completing the course and receiving a commission in the Army Air Corps in June 1929.

After tours with two pursuit squadrons at Selfridge Field, Michigan, from 1929 to 1933, Putt was assigned as a test pilot in the Air Materiel Division at Wright Field in Dayton, Ohio.

Putt's assignment to the Flight Test Branch at Wright Field marked the start of a career devoted exclusively to research and development. After surviving the crash of a Boeing Model 299 bomber (the prototype of the B–17) that he was co-piloting in October 1935, Putt entered the Air Corps Engineering School at Wright Field the next year. Upon completion of the year-long course in the summer of 1937, he attended the California Institute of Technology, earning a master's degree in aeronautical engineering in June 1938. While at Caltech, Putt studied under and became a life-long friend of Theodore von Karman, the head of the school's Guggenheim Aeronautical Laboratory and future chairman of the Air Force's Scientific Advisory Board (1946–1954). Reassigned to Wright Field, Putt held several engineering positions, including chief of the Experimental Bombardment

Aircraft Branch during the development of the B–24, B–29, and B–36. In late 1944, he went overseas as chief of technical intelligence for the U.S. Strategic and Tactical Air Forces in Europe, a post he described as "a small extension of Wright Field." With the end of the war, he returned to Dayton, becoming deputy chief of Air Materiel Command's Engineering Division.

In September 1948, Putt was appointed director of research and development on the Air Staff, the first of the highest-level Air Force R&D positions he was to hold during the next decade, and from which he guided the development of a jet aircraft and missile force able to operate both in the atmosphere and in space. Instrumental in establishing the Air Research and Development Command, he became its vice commander in January 1952, and its commander in 1953. He went back to the Pentagon in April 1954 as the Air Force's deputy chief of staff for development, where he served until retiring in 1958.

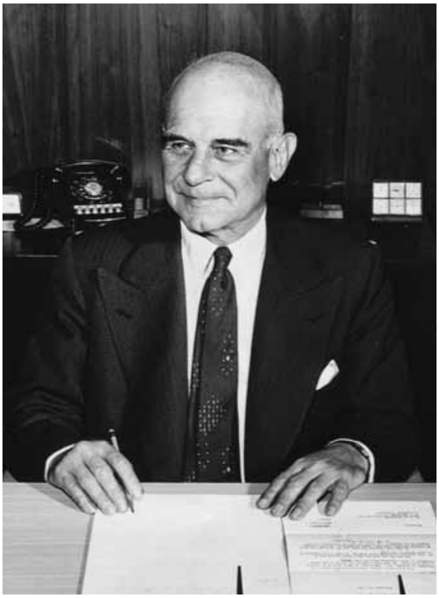
After leaving the Air Force, Putt became the first president of United Technology Corporation (initially United Research Corporation), an aerospace firm located in California that specialized in developing large solid-fuel rocket engines. While he was president of United Technology, Putt also chaired the Air Force Scientific Advisory Board. In late 1961, several articles in the *New York Times* noted that Putt's company had been awarded a $2 million Air Force research contract and, although not alleging wrongdoing, questioned the propriety of his serving on the board in circumstances with such obvious conflict-of-interest implications. The revelation prompted Secretary of Defense Robert McNamara to initiate an investigation of the membership of Department of Defense advisory boards, and ultimately to the requirement for members of government advisory boards to complete periodic statements of employment and financial interests.[I]

Several "field grade" officers (colonels, lieutenant colonels, majors) supported the efforts of the generals in advancing the interests of research and development in the Air Force. General Putt referred to them as "Young Turks"; they called themselves "Junior Indians." Their informal leader was Col. Bernard A. Schriever, who in 1948 was chief of scientific liaison in the Office of the Deputy Chief of Staff for Materiel on the Air Staff. After the Korean War, he would become director of the Air Force's successful ICBM program and would later head the independent R&D command that he was pushing for in the late 1940s (see chap. 9).[67]

During their campaign, these partisans of an independent and expanded role for research and development made numerous criticisms of the Air Force's postwar R&D program. They claimed that Air Force leaders, while acknowledging advanced technology's importance, had failed to impart that awareness sufficiently throughout the service. In their view, the Air Force also lacked effective mechanisms for integrating technological advances with strategic planning. They pointed out that the responsibility for managing research and development, whether on the Air Staff or at subordinate levels, was fragmented. The absence of a strong organizational focal point, they asserted, contributed to other deficiencies. For one thing, funds for research and development were not always controlled by those responsible for managing research and development programs or were not concentrated on the most important development efforts. Also, the Air Force had too few officers with scientific and technical qualifications and lacked an attractive career progression for those who did. Finally, R&D facilities were poorly equipped and inadequate in other respects for the tasks they were supposed to perform.[68]

According to the critics, weaknesses in the research and development program reflected a conscious choice made by the Air Force, faced with tight budgets, to give highest priority to maintaining an "Air Force-in-Being" at the expense of creating the cutting-edge technology "Air Force of the Future" envisioned by Arnold. Consequently, they said, only short-term improvements resulted; the long-range development of highly advanced systems languished.[69] In reviewing the Air Force's postwar R&D program near the end of the Korean War, one officer recalled that the service had not initiated a single new aircraft prototype from 1946 to 1949. "We strove," he said, "to maintain the quality of the aircraft in our force by modification, and we re-shod our old horses until they just plain died of old age."[70]

The small band of R&D proponents lacked sufficient influence to achieve their goals by themselves. But adroit political maneuvering enabled them to secure the broader and higher-level support they needed. Initially, they worked through the Scientific Advisory Board, whose members also supported increased importance for research and development. Putt, the board's military director, and the Young Turks believed that the board's formal endorsement would strengthen their cause. In preparation for the Scientific Advisory Board's meeting in April 1949, Lt. Col. Theodore F. Walkowicz, its military secretary and one of the "Junior Indians," had drafted the remarks that General Fairchild, the vice chief of staff, would give to the board. Fairchild, an R&D supporter, asked the board to form a committee to review the service's approach in this area. Doolittle would be its vice chairman. When the committee's report was finished in September 1949, Putt asked Doolittle to help persuade General Vandenberg, the chief of staff, to approve its recommendations for a fundamental restructuring of the Air Force's organization for research and development. Doolittle carried out his mission on a duck hunting trip with Vandenberg. The latter, while generally agreeing with the study's conclusions, requested another review to be conducted by an all-military panel, chaired by the commander of the Air University, which was responsible for the Air Force's professional military education program. The Air University group submitted its report in November 1949.



Lt. Gen. James H. Doolittle (retired), special assistant to the Air Force chief of staff, 1951–1959. Courtesy, Special Collections, U.S. Air Force Academy Library.

Both studies expressed a concern for the Air Force of the future. In his cover letter forwarding the report of the Scientific Advisory Board's committee to the chief of staff, board chairman von Karman linked the development of a technologically advanced Air Force directly to the preservation of national security:

> The Air Force is the arm which promises to play the major role in any war which we can now foresee . . . our margin over our potential enemies lies predominantly in the technical superiority which we now enjoy, and must maintain. It would be very dangerous for us to suppose that we can remain secure by making technical progress at anything less than the maximum rate of advance we can achieve.[71]

General George C. Kenney, the Air University commander, sounded the same note in the letter that he attached to his organization's report. "There has been evidence from many sources," he told General Vandenberg, "that the Air Force is seriously deficient in providing for its own future strength, a strength which may well be of critical importance to the security of our country."[72] With respect to organization, both committees recommended the creation of a field operating agency devoted solely to research and development and the establishment of an Air Staff position to assume policy responsibility for the Air Force's R&D program. Both groups anticipated that giving research and development more autonomy and more resources would help solve the problem of favoring short-term operational needs to the detriment of advanced weapons development.

These arguments convinced General Vandenberg that the proposed reorganization was necessary. Consequently, in January 1950, the Air Force announced the formation of the Research and Development Command (redesignated the Air Research and Development Command in April) to conduct day-to-day R&D activities, and a new Air Staff position, the deputy chief of staff for development, to provide policy direction. Aware that implementation of the reorganization would likely cause friction, Vandenberg appointed Doolittle as his special assistant to smooth the transfer of functions by arbitrating differences that might arise.

The events of the past are sometimes dramatically portrayed as a titanic struggle over well-defined issues involving momentous stakes and conducted by homogenous groups—one obviously "good" and the other unmistakably "bad." Several historians have described the drive to increase the importance of research and development in the Air Force during this period in such terms—a conflict between an enlightened and progressive faction on the one hand and a shortsighted and conservative element on the other. According to one of these scholars, it was a fight involving "technologically oriented officers who promoted the 'Air Force of the future' versus the traditionally minded pilots who focused on the 'Air Force of the present.'"[73] To another it was a "struggle between the conservative and the more innovative-minded managers," the former handicapped with "blind eyes."[74] According to yet another historian, even after autonomy for R&D had been achieved with the creation of Air Research and Development Command (ARDC), the "risk-taking" outlook that prevailed in the new command continued to battle the "conservatism" that dominated the Air Materiel Command (AMC).[75]

Despite the seductive appeal of such colorful and sharply defined interpretations, historical reality is normally less clear cut; its currents do not follow neat channels, and its waters are muddy. Research and development may have suffered some at the hands of those in the Air Force attempting to maintain a viable force-in-being, but the portrait of stubborn, almost Luddite-like conservatives opposing organizational independence for and a greater emphasis on R&D—and thereby jeopardizing the service's future—is overdrawn.

More important than any internal obstacles were funding limitations imposed from outside the Air Force. In FY 1946, the AAF's appropriation for research and development was $254 million, which dropped sharply to $110 million in FY 1947, about one-third of its request. In FY 1948, the R&D funds rose to $145 million, an amount that was still far short of the $347 million the service wanted.[76] The cuts, Secretary Symington reminded the Air Staff, came not from Congress but from the War Department and the Bureau of the Budget.[77] In December 1947, in a letter to Budget Bureau Director James E. Webb, Symington strongly protested the decision to slice the Air Force's research and development funding for FY 1949 by 30 percent.[78]

Symington also forwarded a copy of his letter to newly appointed Secretary of Defense Forrestal, hoping for support.[79] But in succeeding years, both the Office of the Secretary of Defense and even the Research and Development Board, which established the funding level for each service's R&D, proved just as eager as the Bureau of the Budget to restrain spending. In planning for the FY 1950 budget, Forrestal, following a recommendation from Vannevar Bush, chairman of the Research and Development Board, established a $550 million ceiling on the total of the R&D programs for the services. At the time, the Air Force alone had requested nearly $440 million (it eventually received $237 million). Louis Johnson, Forrestal's successor, was even more tight-fisted, setting the FY 1951 planning ceiling at $500 million and FY 1952's at $510 million.[80] The rationale Bush offered for holding funding down for FY 1950—reasoning that continued to be used by subsequent Research and Development Board chairmen and OSD—was that the nation did not have enough qualified scientists and engineers to support greatly expanded military research and development programs.[81]

Denied the sums it believed essential, the Air Force sought to supplement its limited R&D funds with money originally appropriated for procurement. These were not token transfers. In FY 1948, about $70 million in production money was added to the research and development appropriation.[82] Early, in 1950, the Air Force comptroller indicated that it had not been unusual for R&D budgets to be enlarged by 50 percent or more in this way since the end of World War II.[83]

Moving funds from one budget appropriation category to support activities in another was technically legal but not looked upon favorably by either Congress or the Research and Development Board. Congress disliked the practice because fewer aircraft came off the assembly line than the Air Force had indicated it planned to buy.[84] The Research and Development Board was unhappy because mixing funds from the two categories made it more difficult to monitor the services' research and development programs.[85]

From the perspective of Air Force R&D partisans, however, the infusion of procurement funds was misleading because much of the added resources went toward improving current systems and not for designing and developing future weapons that would assure the Air Force's long-term technological superiority. Early in 1948, General Joseph McNarney, head of the Air Materiel Command, conceded that "most of the development that is being paid for out of production funds is a development of an airplane already in being—its further development."[86]

Nonetheless, some procurement money was used to develop advanced systems. In fact, in 1951, Lt. Gen. Edwin W. Rawlings, who had recently taken over the Air Materiel Command, complained about the use of procurement funds for systems under development that were markedly different from systems already in production. Summarizing past practice for Lt. Gen. Orval R. Cook, the Air Staff's deputy chief of staff for materiel, Rawlings stated:

> Since World War II the Air Force has negotiated an engineering allowance in the production contracts for "production engineering" and "product improvement." "Production engineering" was normally accepted as including (1) the correcting of deficiencies and malfunctions of equipment present being produced or previously produced, i.e., service engineering, and (2) the redesign of the equipment and/or its method of manufacture to increase its producibility. "Product improvement" was generally defined as the model to model improvement, usually small increases in performance or durability due to resolving faults and inefficiencies in the production

> article. However, in the *last few years* this term "product improvement" has been stretched considerably. Development of completely new equipment has been paid for by these allowances on production contracts. Even though these equipments so developed were completely different in each and every part from the equipment being produced and gave large increases in performance (50%-75%), they were of the same category or type of product and used principles, processes, and theories which were used or found in the production article.

Rawlings cited the development of two advanced jet engines, the J71 and the J73, as having been inappropriately supported with production funds meant to pay for manufacture of the J35 and J47 engines.[87]

Still, even with the addition of some limited production funds, the cost of maintaining the force-in-being had eaten into money intended solely for research and development of future systems, causing some long-range, advanced technology projects to be curtailed. Missile programs, as previously noted, experienced drastic cuts in the years before the Korean War. Other systems were also affected. Early in 1949, for example, the Air Force, pressed to enhance the near-term capability of its strategic bombing force but required to do so without a budget increase, withdrew funding that would have carried two experimental engine projects from research and design into the hardware stage.[88]

It is unnecessary to deny that a technologically superior Air Force was a crucial component of national security or that the service's development of advanced systems might have been further along had more resources been applied in order to suggest that contemporary R&D partisans (and some historians later) may have exaggerated their case. At no time did the Air Force completely abandon long-range development. Some missile projects were cut sharply, but others went forward. The Air Force also continued to support other technologically ambitious projects. Beginning in 1946, for example, it annually allocated funds for the (ultimately unsuccessful) nuclear-powered bomber. By 1951, when the Atomic Energy Commission began to share expenses for the nuclear bomber, the Air Force had provided approximately $20 million to the contractor, the Fairchild Engine and Airplane Corporation.[89]

Favoring the "Air Force-in-Being" over the "Air Force of the Future" was an issue of degree not of kind. Air Force leaders all understood the potential consequences of sacrificing some long-range development. But giving the edge to the force-in-being was not a manifestation of hidebound conservatism; it reflected the heavy responsibility imposed on the service by the nation's dependence on the strategic air offensive. Within six months of the formation of the Air Research and Development Command, those focusing on the force-in-being would find more support for their position—the Air Force had its hands full in Korea and would soon begin the substantial and rapid rearmament that NSC 68 had said would be necessary to be ready for a possible world war by mid-1952.

DETERMINING REQUIREMENTS

Requirements drive acquisition. Indeed, determining the need for a system initiates the acquisition process. Materiel requirements fall into two broad categories: the qualitative requirements—the types of systems to be developed, and the quantitative requirements—the numbers of each system to be produced along with spare parts, and the kinds and amounts of manufacturing materials required. When weaknesses were discovered in the methods the Air Force used to determine both kinds of requirements in the late 1940s and early 1950s, the service, albeit usually under outside pressure, took steps to correct the problems.

The Air Force's requirements system had evolved gradually after achievement of independence in 1947. Before separating from the Army, the Army Air Forces received approval for its materiel requirements through the War Department General Staff. Anticipating the need for an authorizing mechanism on the Air Staff for those requirements when the Air Force became independent, the Army Air Forces formed the Aircraft and Weapons Board in the summer of 1947. Its members included the vice chief of staff, the deputy chiefs of staff, and the commanders of the principal commands. The under secretary of the Air Force sometimes attended the board's meetings, although the regulation setting up the board did not list the under secretary or either of the assistant secretaries as official members.[90] Less than a year after its establishment, the Aircraft and Weapons Board was dissolved and replaced by a succession of Boards of Senior Officers appointed by the secretary of the Air Force. The first of these met in December 1948, the last in May 1951. The Air Force Council, established in April 1951, superseded the Boards of Senior Officers.[91] Although the military composition of the three bodies differed slightly (only the Aircraft and Weapons Board, for example, included the commanders of the major operating commands), each performed essentially the same function with respect to acquisition—advising the chief of staff and the secretary of the Air Force regarding the development and procurement of major systems.[92]

In the Air Force, the determination of both qualitative and quantitative requirements was almost entirely an all-military affair. Stuart Symington, the first secretary of the Air Force, was particularly deferential in this regard. For example, the winter of 1947–1948 saw Air Force officials debating whether to renew the Boeing Company's development contract for the XB–52, the leading candidate for a long-range bomber to succeed the B–36, or to initiate a new, industry-wide competition to design the follow-on system.[93] After a visit from a Boeing Company executive who was attempting to convince the Air Force not to cancel the contract, Symington wrote to General Spaatz, the chief of staff, that he had tried to avoid discussing the B–52. "This was not difficult," he said, "because I don't know much about it." Symington believed that his job was to obtain for the Air Force the systems its military professionals thought were needed.[94] Years later, General Lauris Norstad, who as deputy chief of staff for operations from late 1947 through early

1950, was responsible for recommending to the Aircraft and Weapons Board (and then to its successor, the Board of Senior Officers) both the types of systems to be developed and the number of each to be purchased, confirmed Symington's role: "In no way did he ever generate requirements. Those came from me, and they came to me from the using commands." Moreover, recalled Norstad, "never, never did he suggest we change our requirements or go with a different company."[95]

Other Air Force civilian leaders were somewhat more aggressive when it came to influencing weapons development. In mid-1950, John McCone, the under secretary of the Air Force, suggested that the United States should organize a Manhattan-type project for developing guided missiles to defend against Soviet aircraft carrying nuclear weapons. His proposal envisioned a missile "czar," titled the "Managing Director," who would possess almost complete control of the military's missile programs. According to the plan, the Managing Director would "consult" with the services regarding their missile needs. But then, supported by a staff that he had selected, the Managing Director would control all missile appropriations, administer all missile development contracts, and be responsible for all missile research and development, including testing of missile prototypes. The services would be left with procuring the missiles when they were sufficiently developed. The Managing Director would report to a "Board of Directors," comprising the service secretaries and the chairman of the Research and Development Board. Not surprisingly, the Air Staff was unhappy with the plan. It effectively eliminated the Air Force, particularly the uniformed military, from meaningful involvement in the types of systems to be developed. Also, its defensive orientation, especially its emphasis on developing short-range, surface-to-air missiles, would favor the Army.[96]

But the airmen need not have worried either about McCone's plan or increasing civilian influence over qualitative requirements. Although Secretary of the Air Force Thomas K. Finletter, Symington's successor, had endorsed the under secretary's proposal, it was overtaken by events. In the fall of 1950, President Truman appointed K. T. Keller, president of the Chrysler Corporation, to take charge of the military missile program, but subject to the authority of the secretary of defense. Also, in his capacity as missile "czar," Keller quickly showed that his main concern was to get missiles into production and operational; he showed no inclination to tell the military which ones to develop (see chap. 3). Finally, McCone, perhaps the most assertive of the Air Force's civilian leaders when dealing with the uniformed military, left the under secretary post within a year.

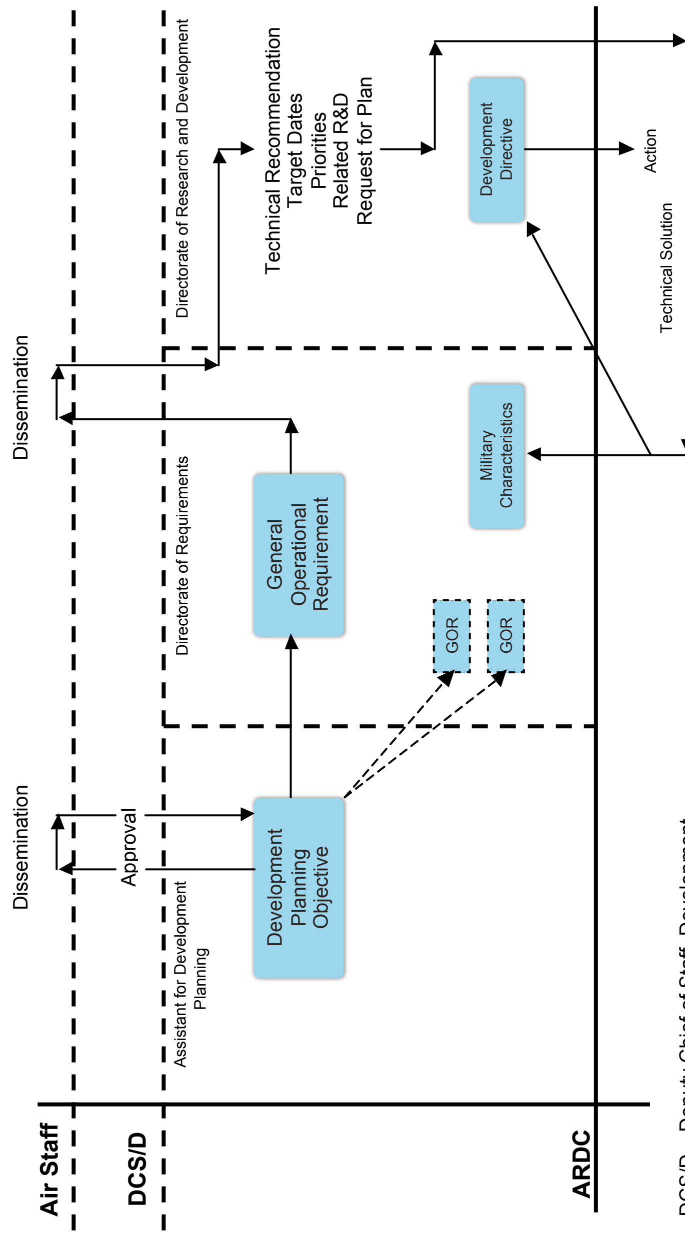
For the most part, then, professional airmen were left largely to themselves with respect to qualitative requirements and, thus, had little incentive to examine critically the process they used for determining them. Their apparent satisfaction with the status quo, however, began to erode as a result of the findings of several studies conducted in 1949. In July, one of these, a review of Air Staff organization undertaken by Edward P. Learned of the Harvard Business School at the request of Vice Chief of Staff General Fairchild, pointed out weaknesses in the way the Air Force selected systems for development. These included a diffusion of staff responsibility for determining qualitative requirements; the absence of a formal system to identify and order priorities for new weapons; and ineffective coordination between the Air Staff and the Air Materiel Command that resulted from the lack of a headquarters focal point. Responding quickly to Learned's survey, General Fairchild reorganized the Air Staff in August 1949. One of the changes affected the organizational responsibility for generating qualitative requirements. Formerly, the function had been combined with training in a directorate under the deputy chief of staff for operations. The reorganization directed by Fairchild made requirements a separate directorate, although still under the deputy chief of staff for operations.[97]

While rearranging boxes on the Air Staff organization chart might have helped clarify responsibility for determining qualitative requirements and have increased the function's visibility and importance, it did little to correct one of the major flaws in the requirements process identified by Learned—the lack of a systematic approach to weapons selection. An attempt to come to grips with this problem followed the reorganization that set up the Air Research and Development Command in early 1950.

To understand how this came about, it is necessary to look back to the fall of 1949 when, as noted earlier, reports from the Scientific Advisory Board and the Air University charged that advanced weapons development was being severely neglected at the expense of satisfying the short-term needs of the operating forces. The establishment of a deputy chief of staff for development and the formation of the Air Research and Development Command early in 1950 were intended to address this deficiency. As part that reorganization, the director of requirements on the Air Staff was removed from supervision by the deputy chief of staff for operations and placed under the new deputy chief of staff for development.[98]

Uniformed officers and civilians, led by Colonel Schriever, who worked for the deputy chief of staff for development, soon began to design a procedure for integrating advanced technology goals, requirements for specific systems, and available R&D funding. According to this protocol, the deputy chief of staff for development, in coordination with other staff elements, established needs for major weapon systems called "development planning objectives." Based upon assessments in general mission categories (e.g., strategic air operations) that employed "systems analysis" techniques, the development planning objectives (DPOs) reflected both the short-term requirements of the operational commands and longer-term considerations derived from strategic intelligence, war plans, and likely technological advances. The development planning objectives were then translated into several specific "general operational requirements" (GORs) that described the system's desired operational characteristics. In turn, the GORs were furnished to the Air Research and Development Command for preparation of "military characteristics" (detailed performance parameters for each system). After approving the proposed military characteristics, the deputy chief of staff for development issued a "development directive" to the Air Research and Development Command and allocated funds for the program.[99]

AIR FORCE REQUIREMENTS PLANNING
1952



DCS/D – Deputy Chief of Staff, Development
ARDC – Air Research and Development Command

Source: *History of the Air Research and Development Command, 1 July 1951–30 December 1952*, Vol.1., *Narrative*, 144-45.

The earliest development planning objectives concerned strategic air operations. Approved by the Air Force Council in February 1952, one set of objectives initiated development of two new bombers to be available between 1956 and 1960—one for low-altitude penetration, and the other, a smaller and lighter aircraft with a supersonic dash capability, for high-altitude attack. Both bombers were also to have a minimum combat radius (range that included return to the launch base) of 2,300 nm, and to be capable of aerial refueling and delivering nuclear-armed, air-to-surface missiles. The high-altitude system became the B–58 Hustler, but the low-altitude penetrator was not pursued.[100]

On paper, at least, the deputy chief of staff for development had designed a coherent and sophisticated procedure for formulating the Air Force's qualitative requirements and for meshing them with the acquisition process. Its implementation, however, was less than satisfactory. In the spring of 1953, Lt. Col. Peter J. Schenk, Doolittle's assistant and an officer who had been active in the campaign to upgrade research and development and to safeguard the "Air Force of the Future," felt that the requirements system had not lived up to expectations. According to Schenk, there was "an almost complete absence of broad policy guidance to ARDC . . . in the form of GORs. . . . Too many people in the Directorate of Requirements [one of the two organizational subdivisions under the deputy chief of staff for development on the Air Staff] are still too busy approving the introduction of a new fire extinguisher in a certain location in the cockpit of one of our airplanes."[101] In short, in Schenk's view, headquarters was too much involved in the "nuts and bolts" of qualitative requirements, an activity that should have been performed by the Air Research and Development Command, the Air Force's operating agency for R&D. Nonetheless, whatever its shortcomings, by the end of the Korean War the Air Force had instituted a formal process for formulating qualitative requirements that previously had depended largely on "opinion or intuition."[102]

As a result of the reorganization of research and development in 1950, the deputy chief of staff for operations had surrendered primary responsibility for generating qualitative requirements to the newly established deputy chief of staff for development, but the former continued to be the principal source of the Air Force's quantitative requirements—the type and number of major systems (principally aircraft)—to be purchased during a fiscal year. This determination flowed from the overall force structure (i.e., number of wings) approved for the Air Force and from the tasks assigned in war plans drawn up by the Joint Chiefs of Staff. Once the decision to buy certain types and numbers of systems had been made, the deputy chief of staff for materiel and the Air Materiel Command estimated the subsystems, spare parts, and manufacturing materials required to produce the major end items, and initiated and administered the purchase contracts.

The uniformed military had less autonomy in determining quantitative requirements than it did in selecting particular systems for development; the numbers of each system to be procured would have much greater budgetary impact and thus political implications. Probably for this reason, Secretary Symington decided that the Air Force's civilian leadership should participate officially in the deliberations of the Board of Senior Officers that he established at the end of 1948 to succeed the Aircraft and Weapons Board. In July 1949, he directed that the new board, after initial deliberations on a projected procurement but *before* making recommendations to the chief of staff and to himself, should consult with the under secretary of the Air Force "as to the business and industry aspects of such proposals. . . ."[103] Still, this was a relatively modest intrusion by civilian officials and came near the end of the process for determining quantitative requirements.

When the military buildup began after mid-1950, the Air Force's system for estimating its quantitative requirements seemed to be in good shape. Late in the year, as described in chapter 3, the chairman of the Munitions Board commissioned the Harvard Business School to look into the Defense Department's methods, procedures, and organization for determining materiel requirements. The review did not examine how the services came up with types and numbers of systems to be procured but instead evaluated how those end items were translated into quantities of materials and assigned delivery schedules. In the Air Force, the deputy chief of staff for materiel and the Air Materiel Command were responsible for these activities. Issued in March 1951, the Harvard Business School report concluded that "the framework and procedures for the calculation of quantitative requirements in the Air Force are basically sound."[104] The assessment, however, was conducted rapidly and very early in the rearmament period. Its conclusion was invalidated by the deficiencies in the Air Force's quantitative requirements estimates that showed up under the demands of the Truman administration's military buildup.

The faulty requirements estimates came to light near the end of 1951 when Congress began criticizing the slow pace of rearmament. The Office of Defense Mobilization and its subordinate control agencies, the Defense Production Administration and the National Production Authority, blamed the slowdown in part on poor estimates for machine tool and raw material requirements and unrealistic production schedules provided by the armed services (see chap. 3).

The Air Force conceded that it had problems estimating its requirements, especially in drawing up accurate delivery schedules, but it maintained that the causes lay outside the service. Pressing this point, Under Secretary of the Air Force Roswell Gilpatric (McCone's successor) wrote H. R. Boyer, chairman of the ODM's Aircraft Production Board, that programming would have been better if the government had given greater emphasis to making resources available for military purposes by immediately expediting machine tool production and by instituting a controlled materials plan. The Air Force, explained Gilpatric, mistakenly assumed that such steps would be taken.[105]

In September 1952, reacting to congressional insistence that service spending on materiel come under greater internal scrutiny, the secretary of defense directed each military department to establish an office reporting directly to the service secretary that would "audit and review" materiel requirements and monitor the methods for computing them.[106] Consequently, on 1 January 1953, the Air Force established the Office of Analysis and Review. But, as finally constituted, the Air Force office and those of the other services did not possess any real power. They lacked authority to probe the assumptions underlying the validity of new requirements and were restricted from operating outside departmental channels, which would bring them under OSD's influence.[107] Not long after the Eisenhower administration took control of the Department of Defense, OSD allowed the services to abolish the departmental review agencies. By September 1953, the Air Force's Office of Analysis and Review had disappeared from the organizational chart of the Office of the Secretary of the Air Force.

MANAGING THE ACQUISITION PROCESS

As the nation's first line of defense, the Air Force needed to respond immediately and effectively with a force-in-being should war occur. At the same time, airmen expected to prevail over an opponent through superior technology, not strength of numbers. But maintaining a force in a high state of readiness that was also equipped with the most advanced technology proved difficult after World War II. Technological advances in air warfare occurred so fast and in so many areas that incorporating them into a weapon system was a daunting challenge. Moreover, the tight budgets of the late 1940s limited the extent to which technology could be exploited. More money became available after mid-1950, but the urgency of the rearmament forced the Air Force to accelerate weapons programs. This raised costs as systems had to be modified after prematurely entering quantity production. Furthermore, the buildup had to be accomplished under a new organizational structure for acquisition in which many responsibilities had not yet been clarified. Nonetheless, by the end of the Korean War, the Air Force had begun to evolve what its leaders believed were more effective management procedures, embodied in the weapon system concept, to achieve the development of an advanced technology force that would also be prepared to fight and prevail on D-Day.

The Development Cycle

The process for developing new aircraft changed considerably in the decade or so from the eve of World War II to the start of the Korean War. Before World War II, the Army Air Corps (the Army Air Forces after 1941) had followed a deliberate, sequential, and slow-paced development cycle. The Air Corps first determined a requirement and performance specifications for a new aircraft, conducted an open design competition, and contracted with the winner to produce a prototype for testing, the "X" aircraft. After tests had been completed and design changes incorporated, the contractor delivered one or more pre-production prototypes, the "Y" aircraft, for further testing and modification prior to quantity production and subsequent delivery to field units. This process could take seven years or more. By the time a new aircraft type reached operational units, it was at or fast approaching obsolescence.[108]

Faced with the prospect of a war for which it was unprepared, the Air Corps abandoned this slow, sequential development protocol. Development and production began to overlap—to take place "concurrently." In 1939, for example, the Air Corps signed production contracts for the B–24 and B–26 bombers before either aircraft had actually flown.[109] Similarly, the machine tools were being designed and the factories were under construction well before the first flight of the B–29 bomber in September 1942.[110] Accelerated acquisition allowed little or no time for testing the system prior to the initiation of production. Changes to improve performance or correct deficiencies were made after production had begun or was completed, and special modification centers were established for this purpose. Even then, because the priority was for masses of aircraft delivered rapidly, the Army Air Forces sought to limit the number of such changes. In September 1943, General Arnold "froze" production designs and required approval from AAF headquarters for any exceptions, a policy that remained in effect until the summer of 1944. Throughout the war, the Army Air Forces emphasized quantity over quality in aircraft acquisition.[111]

The B–29 program saw another important wartime modification of the traditional development process. The standard procedure was to contract for an airframe; the engine, propeller, and other subsystems were developed separately and furnished by the government to the airframe manufacturer. In the case of the B–29, the airframe and some of the aircraft's subsystems, notably its fire control system, were designed together ("concurrently") as a single "system."[112] But the Army Air Forces did not continue its experiment with this approach to aircraft development following the war. Not until the end of the 1940s did the service again attempt to apply the concept.

After World War II, the Army Air Forces sought to reestablish the prewar aircraft development pattern, but could not do so for two reasons. First, funds to purchase prototypes for testing were limited. Second, the sequential, multistage process took too much time if the service hoped to exploit new technologies. For example, rapidly converting to jet power, an especially high priority, caused the Air Force to overlap development with production in some programs as it had during World War II, necessitating numerous expensive modifications during production or after aircraft had been turned over to operational units.[113] The result, too often, was that planes were not combat ready.

By the end of the 1940s, the Air Force's operational commands were complaining loudly and frequently about the lack of combat-ready aircraft. The

Strategic Air Command, whose bombers constituted the most important element of the force-in-being, was especially critical. On 4 January 1950, at a briefing for Secretary Symington and General Vandenberg, Col. Paul W. Tibbets, Jr., SAC's director of materiel (and pilot of the B–29 that had dropped the atomic bomb on Hiroshima), stated that "even though we received the B–50 in February 1948, the B–36 in July 1948, and the F–86 last May, there are major engineering difficulties which remain unsolved and which seriously limit the operational utility of these aircraft."[114] Lt. Gen. Benjamin W. Chidlaw, head of the Air Materiel Command, explained that the compressed development cycle was the primary cause: "The acceleration of aircraft deliveries—without previous thorough service testing of limited quantities represents the major factor in the development of an abnormal rate of deficiencies." Acknowledging the gravity of the situation, he promised "to get SAC out of the woods" as soon as possible."[115]

The Continental Air Command was experiencing similar problems with its aircraft. At the end of January 1950, Lt. Gen. Ennis C. Whitehead, its commanding general, wrote Lt. Gen. K. B. Wolfe, the deputy chief of staff for materiel on the Air Staff, about difficulties with the B–45 bomber and the F–86 fighter. He suggested that additional, although still accelerated, testing of the first few production models might be the answer. Wolfe replied that the problem was not easily solved. Rapid progress in the state of the art, he told Whitehead, required that changes be incorporated to avoid obsolescence even after approval of the basic design. Moreover, the Air Force did not have the funds for multiple prototypes to be used for testing before starting quantity production; nor could it afford the delay involved. Wolfe did concede, however, that additional accelerated service testing might be warranted. To achieve that, he suggested, "[p]erhaps a slower rate of initial production is indicated."[116]

After mid-1950, the Korean War and NSC 68's ambitious rearmament goals caused the Air Force, like the other services, to accelerate many acquisition programs. In January 1951, recognizing that the speedup would likely increase the difficulty of supplying operational units with modern, combat-ready aircraft, Vice Chief of Staff General Nathan F. Twining directed Maj. Gen. Gordon S. Saville, the deputy chief of staff for development, to examine the problem.[117]

Completed in April 1951, the study, entitled "Combat Ready Aircraft," and largely written by Colonel Schriever, who was on Saville's staff, made several key recommendations. One was to reorient the determination of qualitative requirements from its previous focus on incremental improvements to existing systems toward a balanced consideration of both short-term factors and longer-term assessments that would identify the characteristics desired in a force to be deployed in the future. Another was to create a management structure and process for developing new weapons from start to finish as a complete system. Other important proposals in "Combat Ready Aircraft" involved the development cycle. The study pointed out that acquisition time could be shortened by making the decision for limited production at the time the contractor presented a mock-up of the system and by eliminating the "X" and "Y" prototypes. To ensure system serviceability, initial production would proceed at a slow rate and the first few units would be tested thoroughly to determine necessary modifications.[118] In December 1952, to support the acquisition approach outlined in "Combat Ready Aircraft," the Air Research and Development Command established the policy that a single prime contractor would be responsible for integrating all of a weapon's subsystems, including those developed by other contractors.[119]

By the end of the Korean War, the Air Force had implemented most of the recommendations in "Combat Ready Aircraft." Taken together, they constituted an articulation of the key elements of the weapon system concept, which promised a solution to the challenge of maintaining a combat-ready force equipped with the latest technology.[120]

The Weapon System Concept

The "Combat Ready Aircraft" study of early 1951 called for new aircraft to be developed as complete weapon systems. Referring to a weapon as a "system" had become common in scientific and military circles in the second half of the 1940s. At RAND, which was closely tied to the Air Staff, the term "weapon system" was everyday language and "systems analysis" the organization's hallmark. As applied to aircraft, the term weapon system included not only major subsystems such as the airframe, engine, armament, and navigation and communications equipment, but also aspects of employment such as supporting ground facilities and equipment and specialized training for the system's operators.[121]

The notion that new aircraft should be developed as complete systems evolved gradually after World War II. As mentioned previously, the Air Force had used this approach to a limited extent with the B–29 during the war, but did not pursue it in the service's postwar development programs. The standard practice continued to be that an aircraft's subsystems were developed independently and, if necessary, modified for compatibility with the airframe. But engines and other electronically driven subsystems such as fire control and navigation were becoming increasingly complex and normally required considerably more time to develop than the basic airframe.[122] To solve this problem, planners at first attempted to coordinate the development of subsystems so that all would be ready to assemble into the complete product at the same time. But this failed to ensure subsystem compatibility and the achievement of optimum system performance that result from it.[123]

By 1949, the weapon system concept had come to reflect a more complex development strategy: All of the elements in a system should be designed and developed from the beginning as an integrated whole. Bell Telephone Laboratories was the first to implement this approach in its development of the Nike Ajax surface-to-air missile system for the Army beginning in 1945 (see chap. 11). But the Air Force, alone among the services, would apply the concept to all of its weapon systems in the 1950s. In May 1949, General Fairchild was familiar enough with the weapon system idea to promote it before a group of industry representatives called to Washington to hear a series of presentations by Air Force officers on the air defense problem.[124] By the end of the Korean War, the new approach was the Air Force's preferred development strategy. In December 1952, Major General Putt, Air Research and Development Command's vice commander, informed the head of the Wright Air Development Center, the Air Research and Development Command's principal subordinate unit, that "the complete weapon system—the aircraft or guided missile, its components, supporting equipments, and USAF preparation for its implementation as a weapon—should be planned, scheduled, and controlled, from design through test, as an operating entity."[125]

To apply the weapon system concept at the field level, the Air Force developed a specialized management structure. Referred to initially as a "joint project office" and later as a "weapon system project office," the new organizational arrangement evolved slowly.[126]

Through the end of the 1940s, the Air Materiel Command had assigned two "project officers"—one for development and one for production—to monitor each system's acquisition. Since the Air Materiel Command was organized functionally—essentially by subsystem specialty (e.g., propulsion, armament, and communications) and not by weapon system—the project officer responsible for a system during its development phase coordinated with specialists within the command who monitored the status of each subsystem. In contrast, project officers for the production phase were assigned to a contractor, not to a particular system, and were usually responsible for overseeing work on several different systems being manufactured by that company.

The rapid rearmament following mid-1950 demanded closer coordination between a system's development and production phases. In early 1951, to meet this need, the Air Materiel Command established "joint" project offices (initially for high-priority programs such as the B–47 and B–52) in which the project officers for development and production shared acquisition responsibility. Such dual direction did not always work smoothly. Carrying it out became even more difficult as the newly established Air Research and Development Command gradually took over R&D functions and personnel from the Air Materiel Command and began to provide the project officer for the engineering aspects of a system's acquisition. When the project officers from the two commands did not agree, resolution of a dispute, rather than taking place within the same organization as before, now required negotiation between two separate field operating agencies that were often in conflict with each other.

Although the two commands sought to clarify authority within a project office by designating the Air Research and Development Command representative as "team captain" while a system was under development and then passing the leadership baton to the Air Materiel Command project officer when it entered production, they could not agree on the point where development ended and production began. In late 1952, the problem of "who's in charge here" eased somewhat with an agreement between Lt. Gen. L. C. Craigie, the deputy chief of staff for development, and Lt. Gen. Orval Cook, the deputy chief of staff for materiel. Announced in a letter to the field commands signed by General Vandenberg, it provided that the Air Research and Development Command would direct an acquisition program until the Air Force decided to produce a system in quantity; at that point, the Air Materiel Command would take the lead.[127]

Application of the Weapon System Concept: The F–102

In 1949, the Air Force decided that Project MX–1554, its program for a new fighter interceptor, eventually to be designated the F–102, would be developed from the outset as an integrated weapon system—the first aircraft to be entirely designed in this way.[128] But the attempt to implement this acquisition approach in a system with major subsystems involving advanced and unproven technologies experienced significant setbacks.

Project MX–1554 responded to the need for a fighter capable of countering the threat anticipated from high-speed and high-altitude Soviet bombers carrying nuclear weapons. None of the Air Force aircraft employed in the air defense role in the late 1940s and early 1950s—the F–89, F–94, and the F–86D—had been originally designed for that mission. Nor did any of the three possess sufficient growth potential for modification to increase their performance measurably.[129] The Air Force expected that the new interceptor would be able to exceed the speed of sound in level flight, operate at night, in inclement weather, and at altitudes above 50,000 feet. For armament, the aircraft would carry only missiles and rockets instead of guns. It was scheduled to be deployed in late 1954.[130]

The Air Force began acquisition of the new interceptor by opening a competition for the aircraft's electronic fire control system, which it believed would take longer to develop than the airframe. In early 1950, the Air Materiel Command sent requests for proposals to 50 firms. By early April, it had received 18 proposals, and in July named Hughes Aircraft the winner, subsequently negotiating a first-year development contract for just over $1.5 million for the company's MX–1179 fire control system.[131] In conjunction with ground support elements, the system would be able to detect, locate, identify, and destroy attacking bombers "automatically," inspiring some to refer to the proposed interceptor as an "inhabited missile" or the "last manned aircraft."[132]

In September 1950, the Air Materiel Command sent requests for proposals to nineteen aircraft manufacturers for the airframe, to be tailored to the fire control system. Six companies responded with a total of nine design proposals.[133] In July 1951, the Air Force selected Convair, the Republic Aviation Corporation, and Lockheed to receive development contracts. The firm with the best mock-up was to be awarded the production contract. By September, however, the Air

Force had dropped the mock-up competition and had settled on Convair's paper design—an airframe configured with a delta-shaped wing.[134] In addition to the Hughes MX–1179 fire control system and Convair's MX–1554 airframe, the Air Force planned that the aircraft would use the powerful Curtiss-Wright J67 engine, still under development when Convair received the airframe contract. In keeping with the weapon system concept, Convair and Hughes were to collaborate in integrating airframe and electronics.[135]

F–102A Delta Daggers on assembly line at Convair plant, San Diego, California.

The plan to apply the weapon system approach in the interceptor program was in trouble almost before it began. Over the summer and early fall of 1951, Air Force officials realized that the high-thrust J67 engine would not be ready in time to meet the interceptor's programmed 1954 deployment. Nor was it certain that the advanced Hughes MX–1179 fire control system would be available. Indeed, it did not appear that an aircraft with the MX–1554 airframe, MX–1179 fire control system, and J67 engine combination could become operational any earlier than 1956. The Air Force could not wait; it needed an interceptor with improved capabilities by 1954 and decided to acquire an interim replacement. In November 1951, after reviewing several proposals, it selected another Convair design, designated the F–102A, that would substitute the Pratt and Whitney J57 engine for the Curtiss-Wright J67; otherwise the airframe and electronic control system (hopefully still the Hughes MX–1179) would remain the same. Development of the "ultimate" interceptor would continue; in fact it would be a logical evolution of the interim version. Moreover, the weapon system approach would still govern both.[136]

By the end of 1952, the attempt to apply the weapon system concept in the interim interceptor program also had gone awry. When it became clear that the MX–1179 fire control system could not meet the F–102A's planned production schedule, the Air Force directed that a less capable Hughes fire control system (two were nearing completion) be substituted. The decision to accept an essentially "off-the-shelf" subsystem constituted a significant compromise of the weapon system approach for the F–102, since development of the Convair airframe and the Hughes fire control system were supposed to proceed hand-in-hand.[137]

Another aspect of the new development concept, the joint project office, also experienced difficulty in the F–102 program. In theory, the project office was to oversee development of the complete system. But in practice, the project office supervised only the airframe; ARDC's Armament Laboratory and AMC's Electronics Branch monitored the progress of the fire control system. In late 1954, AMC's inspector general noted that this diffuse organization hindered effective program control.[138]

Concurrency—the central feature of the weapon system approach—did not fare well in the F–102 program. As previously discussed, during (and even before) World War II, the Army Air Forces had overlapped development with aspects of production and had continued the practice with some new systems after the war. After mid-1950, the urgency of rearmament caused the Air Force to accelerate more programs in this fashion. The weapon system concept, however, brought a new dimension to concurrency. In addition to telescoping development and production, it provided that work on subsystems proceed simultaneously. The combination of these two aspects of concurrency had the potential to complicate acquisition enormously.

Concurrency certainly caused problems in the F–102 program in both senses of the term's meaning. The marriage between the complex Hughes electronic fire control system and Convair's delta-wing configuration could not take place on the schedule originally intended because development of the MX–1179 fire control system had not been initiated far enough in advance of work beginning on the F–102 airframe. Consequently, in developing the interim version of the interceptor, the F–102A, the Air Force abandoned the aspect of the weapon system approach that called for subsystems to be designed together.[139] Even so, the other dimension of concurrency—in which development and production overlapped—continued. By a letter of intent (letter contract) of July 1952, the Air Force authorized Convair to begin work on 2 prototypes to be delivered in June and September 1953, production tooling, and 7 production versions (out of a total of 40 production aircraft that had been ordered). These 7 were to be delivered from January through August 1954, even though the aircraft would not make its first flight until December 1954.[140] However, problems with the aircraft's delta-wing configuration forced significant design changes. Since preparations to produce the F–102A had already begun, the modifications delayed the program and increased its cost.

F–102A Delta Dagger in flight. Note indented fuselage.
Courtesy, National Museum of the U.S. Air Force.

When Convair won the original interceptor contract in July 1951, aircraft had been exceeding the speed of sound for less than four years. Much about the effects of transonic and supersonic flight on aircraft performance was still unknown.[141] Early in 1953, wind tunnel tests conducted by the National Advisory

Committee for Aeronautics demonstrated that, at transonic speeds, Convair's delta-wing configuration induced aerodynamic drag that substantially degraded the performance characteristics the company had advertised for the interceptor. A late 1953 redesign indented part of the fuselage into the famous "coke-bottle," or "wasp-waist" configuration. Performance improved, but additional design changes had to be made in 1954 before the F–102A met Air Force requirements.[142]

The decision to pursue development and production simultaneously in acquiring the F–102A proved costly. In 1955, a program review by the Air Materiel Command revealed that of the 32,000 production tools manufactured for the initial configuration of the F–102A, 24,000 had to be discarded. Of the total of $40 million spent on production tooling by the time of the Air Materiel Command review, almost half had gone for tools that could not be used.[143] Unused production tooling was but one of the reasons for increases that eventually amounted to 150 percent in the F-102A program's cost. Late in 1952, the Air Force had negotiated a definitive cost-plus-fixed-fee development and production contract (6 percent fixed-fee) for the F-102A with Convair for almost $100 million. Beyond this sum, additional costs included $41 million for engineering changes (in excess of the $8,940,000 originally allocated); overruns, $37 million; major redesign, $30 million; flight-test program, $40 million; and miscellaneous, $9 million. Through January 1957, the actual cost of the contract had risen to $256 million.[144]

Concurrency did not work with the F–102 for the same reason that Michael Brown argues it did not succeed in several postwar Air Force bomber acquisition programs. In *Flying Blind: The Politics of the U.S. Strategic Bomber Program*, Brown maintains that the difficulty was not with a particular acquisition strategy, whether sequential or concurrent, but rather the relationship between the strategy selected and the program's development objectives. The more ambitious the objectives—i.e., the greater the technological advances required—the more likely that sequential development would succeed and that concurrency would fail. Conversely, if it was unnecessary to push the state of the art, then the probability that concurrency would fulfill program, cost, schedule, and performance goals increased. Brown notes that nearly every Air Force postwar bomber program was technologically ambitious. He points out, for example, that the B–47 and B–52, both begun in the 1940s, pushed the state of the art to differing degrees, initially employed sequential strategies, and met performance requirements. Problems occurred when the Air Force accelerated the programs and injected concurrency in the early 1950s.[145] The same pattern appeared in the F–102 program: the attempt to incorporate unproven technologies and to overlap development and production was responsible for delays, performance shortfalls, and increased costs.

Configuration Control: The Problem of Design Changes

Throughout the period of rearmament stimulated by war in Korea and NSC 68, the Air Force struggled to bring order to the process of aircraft modification. Greater control of design changes was necessary to meet the strenuous production goals—initially a 95-wing force by mid-1952 and subsequently 143 wings by mid-1953—and to ensure that aircraft would be combat ready when they reached operational units. By the end of the Korean War, the Air Force had adopted measures that it hoped would allow necessary changes to be made without disrupting production or deployment.

The effort to fashion an orderly system for modifying aircraft took place in a double-barreled political context. On the one hand, agencies outside the Air Force applied pressure to limit design changes to avoid production slowdowns. On the other hand, within the Air Force, the attempt to devise modification protocols became entangled in the rivalry between the Air Research and Development Command, supported by the deputy chief of staff for development, and the Air Materiel Command, supported by the deputy chief of staff for materiel.

The external pressure regarding design changes came from several directions. Beginning in the spring of 1951, OSD and the Munitions Board asked the services to limit modifications that might hinder production. By the fall of 1951, the issue increasingly worried the mobilization control agencies. For example, in November, ODM Director Charles E. ("Electric Charlie") Wilson noted in one of his quarterly reports to the president that changes to the B–47 had caused its production to drop below planned levels. In 1952 Congress weighed in on the matter, forcing the secretary of defense and the JCS chairman to defend the need to make changes, despite their own reservations about the practice (see chap. 3).

Prodded from the outside, the Air Force sought to fix the aircraft modification process but found the task complicated by friction between the "developers"—the deputy chief of staff for development and the Air Research and Development Command—and the "producers"—the deputy chief of staff for materiel and the Air Materiel Command. The major point of disagreement was the boundary between development and production. The deputy chief of staff for development and the Air Research and Development Command maintained that development continued through production and into deployment. In contrast, the deputy chief of staff for materiel and the Air Materiel Command argued that production factors must be considered at the very beginning of system design.[146] The developers especially feared that by surrendering control of changes too early in a system's life, its quality—indeed, the Air Force of the future—would be jeopardized.[147] The producers, who were determined to deliver a combat-ready, force-in-being on time and in the programmed quantity, sought to hold changes to the absolute minimum.

The scope and urgency of the rearmament that began after mid-1950 returned production to the ascendancy in Air Force acquisition that it had enjoyed throughout most of World War II. Before the Korean War broke out, the Air Force had proposed buying 1,472 airplanes in FY 1951 costing about $1.5 billion. After three supplemental appropriations, the Air Force's budget for aircraft procurement in FY 1951 had grown to more than $10 billion. Military aircraft production stood at approximately 200 planes per month in January 1951; by May, the schedule approved by the Munitions Board called for a rapid increase to 1,300 planes per month by the end of 1952.[148]

Achieving such ambitious goals seemed to call for extraordinary measures. In early spring 1951, Lieutenant General Wolfe, the deputy chief of staff for materiel, warned General Twining, the vice chief of staff, that with so much money available, demands for engineering changes to both aircraft in production or already in service would likely increase. "Unless forceful action is undertaken to off-set the aforementioned trends," he wrote, "there is grave danger that availability of the maximum possible number of combat aircraft and other aircraft required in support of combat operations will be jeopardized during the next two years." Wolfe proposed that strict controls, essentially amounting to a freeze, be placed on modifications to production or in-service aircraft and that exceptions be approved by the vice chief of staff. In support of his recommendation, Wolfe reminded Twining that General Arnold had taken similar action during World War II "without detriment to the combat effectiveness of the Air Force and with exemplary benefit to the number of aircraft in the inventory."[149]

General Nathan F. Twining, vice chief of staff, 1950–1953; chief of staff, 1953–1957, U.S. Air Force; chairman, Joint Chiefs of Staff, 1957–1960. Courtesy, Special Collections, U.S. Air Force Academy Library.

In April 1951, Twining approved the "freeze" to modifications on production and in-service aircraft recommended by Wolfe. The ban was nearly total; only a few types of changes would be considered. These included modifications to make a production aircraft able to function mechanically, to correct mechanical deficiencies revealed in in-service aircraft, to ensure aircraft and crew safety, and to increase the rate of production (so long as quality did not suffer). Except for emergency changes essential to avoid production delays, all other modifications would require the vice chief of staff's approval.[150]

Officers on the Air Staff responsible for ensuring the "quality" of the Air Force thought the freeze too restrictive. Major General Putt, then the assistant deputy chief of staff for development, bluntly told Maj. Gen. William F. McKee, the assistant vice chief of staff, that "it wouldn't work."[151] In July 1951, Putt asserted that "[u]nless the Air Force is to remain static in its capability, there must be some procedure for obtaining exceptions, when warranted, to the rigid provisions of the [freeze]." Arguing that it was "undesirable" for the vice chief of staff to approve such changes, he recommended that the authority be delegated to the deputy chief of staff for development.[152] Putt's bid, however, was unsuccessful. In an indication of production's clout within the Air Force during this period, General Vandenberg delegated final approval authority for changes to the deputy chief of staff for materiel.[153]

The chief of staff's order, issued on 14 January 1952, had followed a meeting in the office of Under Secretary Gilpatric between top Air Force officials, including the under secretary, and General Vandenberg, and H. R. Boyer, chairman of the Aircraft Production Board. The principal subject under discussion was the necessity for controlling changes to aircraft in production. After the meeting, Boyer reported to ODM Director Wilson that everyone present had agreed that "changes of all types must be necessarily held to an absolute minimum, consistent with the safety and producibility of the aircraft, if we are ever to achieve maximum buildup of production." To ensure appropriate restraint, Air Force officials at the meeting had informed Boyer that the deputy chief of staff for materiel was being delegated authority to approve changes, and that "[p]articular attention will be given changes which will achieve a negligible or questionable improvement in performance. . . .[154]

Although a design "freeze" might help the Air Force achieve production objectives during the rearmament emergency, it was only a temporary solution to the larger problem of configuration control. Shortly after the mid-April 1951 aircraft modification restrictions went into effect, the Office of the Deputy Chief of Staff for Materiel proposed to the Office of the Deputy Chief of Staff for development that design changes be made periodically in "blocks" (i.e., groups).[155] The so-called "block" system had been introduced during World War II and had provided a useful framework for implementing changes in the series designation of a particular aircraft model (e.g., from B–17F to B–17G).[156]

The author of the proposal argued that modifying aircraft in blocks offered several advantages. The concept provided a better basis for assessing the tradeoff between changes that improved some aspects of system performance but reduced others because of the gain in aircraft weight that resulted from the installation of new equipment. It also would supply better data to the deputy chief of staff for development to assist in determining when and what type of aircraft would be required to replace a system already in production. Still other benefits of the block system related directly to the manufacturing process. For example, introducing several changes at once, rather than one by one, would improve production efficiency. Additionally, since some proposed changes would be eliminated as decisions were made about what to include in a block, manufacturing costs should also decline. Finally, the block system should also improve combat readiness because the equipment items waiting approval with others as part of a block would receive additional testing.[157]

By the fall of 1951, the deputy chief of staff for materiel and the deputy chief of staff for development had agreed on the procedures to be followed in implementing the block system. The original proposal had encompassed only those changes affecting aircraft in production, but, at the insistence of the deputy chief of staff for development, modifications recommended for in-service aircraft were also included. Issued as a headquarters operating instruction, the new procedure went into effect in early November 1951.[158]

Almost a year later, the Air Force took another important step to solve the conflict between the need to make changes improving system performance while at the same time meeting production schedules and providing combat-ready aircraft to operational units. In the same letter that had identified the decision to enter into quantity production as marking the point that leadership in the joint project office would pass from the Air Research and Development Command to the Air Materiel Command, General Vandenberg also specified a change in procurement policy. From then on, the initial production of new systems would be held to the minimum rate necessary to supply enough quantities of the end item to satisfy testing requirements. "Once the testing program has demonstrated the final aircraft or equipment configuration suitable for issue to the using agencies," directed the chief of staff, "the rate of production will be increased to the level needed to meet inventory requirements."[159]

Formal adoption of the low initial production rate in the fall of 1952 put into effect the recommendations previously made by Lieutenant General Whitehead, commanding general of the Continental Air Command, and in the Combat Ready Aircraft study. Indeed, the approach had already been chosen for the F–102 program.[160]

The Air Staff's efforts to control aircraft modifications and thereby improve the readiness of operational units did not satisfy SAC commander General LeMay. Early in October 1952, he wrote General Twining complaining that 3,618 changes had been made to the B–47B strategic bomber and 1,147 to its reconnaissance version, the RB–47B, and "as yet we don't have a combat [ready] aircraft in the command." LeMay, conceding that his own command had been guilty of initiating changes, nonetheless wanted much tighter restrictions put in place. He recommended that a board of senior officers, comprised of representatives from the Air Research and Development Command, the Air Materiel Command, and the using commands, review change proposals and

General Curtis E. LeMay, deputy chief of air staff for research and development, 1946–1947; commander, Strategic Air Command, 1948–1957; vice chief of staff, 1957–1961; chief of staff, 1961–1965, U.S. Air Force. Courtesy, National Museum of the U.S. Air Force.

establish a standard configuration for each aircraft type. Once a configuration had been agreed to, only the board could approve additional changes. "I am convinced," wrote LeMay, "that such a program to obtain a more rigid control over the constant change and modification of our aircraft will save us millions of dollars and give us the best combat operational airplane."[161]

Twining agreed that too many changes were being made, but he avoided directly addressing LeMay's proposal for a senior officer review board.[162] LeMay was not easily put off and continued to press the vice chief of staff on the issue, also suggesting that the "product control groups" established by the Air Materiel Command for each aircraft model might operate in conjunction with the senior officer board he was proposing.[163]

Finally, early in 1953, Twining formally rejected the two control mechanisms promoted by LeMay, explaining that they might be an "extra channel" impeding the operation of the current control system. The vice chief of staff offered instead to strengthen the joint project offices by adding representatives of the using commands.[164] When LeMay persisted, Twining once again endorsed the joint project office system, curtly telling SAC's commander that "the existing organization and command structure is adequate to exercise control of production changes."[165]

* * * * *

Following World War II, the Air Force sought to create a force that would be technologically superior to that of any potential opponent and, as the nation's first line of defense, would also constitute a "force-in-being" always prepared for war. To support the first objective, the Air Force solidified its ties forged during the war with the nation's scientists and attempted to enhance research and development's status within the service's organizational structure. The latter effort failed initially, but succeeded on the eve of the Korean War with the establishment of the Air Research and Development Command and the position of deputy chief of staff for development on the Air Staff.

Although Air Force leaders may have disagreed on the need to separate responsibility for managing R&D from procurement and production, none would have denied technology's critical importance. Yet prior to the Korean War, the effort to equip the Air Force with the most advanced systems conflicted with the goal of maintaining a force that was ready for war. To keep up with technology, the Air Force sought to compress the development cycle for some systems by overlapping development with production. This reduced testing, slowed production, and burdened operational units with systems that broke down regularly.

The Korean War and the urgency and scope of the rearmament that followed caused the Air Force to accelerate acquisition even further, sharpening the quality versus quantity dilemma. Some Air Force leaders gave the edge to advanced technology. Early in 1952, Secretary of the Air Force Finletter testified to a congressional committee: "Even at the cost of delay in turning out numbers of aircraft we should, I believe, incorporate those changes which will assure our crews that they have as good, or preferably better, machines than those [enemy aircraft] with which they would have to deal."[166] Later in the year, General Twining presented the other side of the coin to a group of civilian leaders: "[Y] ou have to have enough of a superior article to make it effective. You cannot win with samples. . . . we cannot adopt all the improvements that become available for our aircraft as fast as they appear. To do so would interrupt our production entirely too often."[167]

To satisfy the two competing force requirements, the Air Force made significant changes to its acquisition process in the early 1950s. It hoped that the new system for formulating qualitative requirements would diminish the previous tendency to make ad hoc improvements based on short-term considerations. Institution of the weapon system approach should help to ensure the compatibility of system components. Joint project offices should guarantee coordination between developers, producers, and users. Design "freezes" put into effect in the spring of 1951 would help the Air Force meet its immediate production objectives. For the long term, introducing modifications in "blocks" should provide a more effective method of configuration control. Finally, adoption of an initially low production rate was expected to provide testing sufficient to assure that systems would function satisfactorily when fielded. By the end of the Korean War, however, none of these measures had been in practice long enough to judge their ultimate effectiveness.

Endnotes

1. Transcript of Aircraft Industry Conference, Pentagon, Washington, D.C., 20 September 1945, 5-6, 16, box 60, entry 380 (Office of the Deputy Chief of Staff, Materiel; Executive Office, Administrative Branch, Miscellaneous Informational Records, 1945–1949), RG 341 (Records of Headquarters, United States Air Force), Archives II.
2. Ibid., 19-25, 55. In fact, AAF procurement amounted to 622 aircraft in FY 1946 and 769 in FY 1947. See Robert Frank Futrell, *Ideas, Concepts, and Doctrine: Basic Thinking in the United States Air Force*, Vol. I, *1907–1960*, rev. ed., 216-19. Figures on aircraft and engine production during World War II are from app. B (Wartime Producers of Aircraft) and app. C (Major Producers of Aircraft Engines: July 1940–August 1945), in Irving Brinton Holley, jr., *Buying Aircraft: Matériel Procurement for the Army Air Forces*, 576-82.
3. Stephen L. McFarland, "The Air Force in the Cold War, 1945–60: Birth of a New Defense Paradigm," *Airpower Journal* 10, no. 3 (Fall 1996): 4-15.
4. Walton S. Moody, *Building A Strategic Air Force*, 391-92, 394, 445; and Walter S. Poole, *The Joint Chiefs of Staff and National Policy, 1950–1952*, 49-53. Budget figures are from table 12 (FY 1953 Appropriations), in Doris M. Condit, *The Test of War, 1950–1953*, 284.
5. Carl Spaatz, *Report of the Chief of Staff, United States Air Force, to the Secretary of the Air Force*, 30 June 1948, 10, 13.
6. Lt. Gen. Ira C. Eaker, "Importance of Production to the Army Air Forces," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 29 January

1947, 1, NDU Library.
7. Herman S. Wolk, *The Struggle for Air Force Independence, 1943–1947*, 81. During World War II, the "squadron" was the basic AAF combat organization. Three or four aircraft squadrons constituted a "group." In 1947, the "wing," also comprised of three or four aircraft squadrons, began to replace the group. The number of aircraft assigned to a group or wing varied generally by aircraft type. In early 1950, 30 aircraft usually comprised a heavy bomb group (10 per squadron); 75 aircraft were in a fighter group (25 per squadron). For the evolution and make-up of the group/wing organizational structure, see ltr, W. Stuart Symington to Representative Carl Vinson, 29 March 1950, folder Secretary of the Air Force (2), 1 Jan. 50–31 Mar. 50, box 61, Papers of Gen. Hoyt S. Vandenberg, U.S. Air Force [hereafter Vandenberg Papers], The Library of Congress [hereafter LC], Washington, D.C.; memo, Foster Adams, Director, Progress Reports and Statistics, Office of the Assistant Secretary of Defense (Comptroller), for Mr. McNeil, Assistant Secretary of Defense (Comptroller), 16 June 1953, sub: Why the Number of Wings/Groups is not an Adequate Measure of Air Power, folder 1954 Budget Impact on Air Programs, box 7, Budget Files, FY 1954, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO; William A. Goss, "The AAF," in *Men and Planes*, 58; Wolk, *Struggle for Air Force Independence*, 33; and George M. Watson, Jr., *The Office of the Secretary of the Air Force, 1947–1965*, 104.
8. Warren A. Trest and George M. Watson, Jr., "Framing Air Force Missions," chap. 12 in *Winged Shield, Winged Victory*, 414-16.
9. Budget figures are from table 7 (Congressional Action on FY 1951 Military Budget), in Steven L. Rearden, *The Formative Years, 1947–1950*, 380 (for the original FY 1951 budget); and Condit, *Test of War*, 241, table 5 (FY 1951 Appropriations); 259, table 8, (FY 1952 Appropriations); and 284, table 12 (FY 1953 Appropriations).
10. Force levels are from table 1 (Revisions of FY 1951 Objectives), and table 2 (Revisions of FY 1952 Objectives), in Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 39-40.
11. Ibid., 53.
12. Michael S. Sherry, *Preparing for the Next War: American Plans for Postwar Defense*, 52-57.
13. For an articulation of this view, see Spaatz, *Report of the Chief of Staff*, 30 June 1948, 19, 51.
14. See especially, Michael E. Brown, *Flying Blind: The Politics of the U.S. Strategic Bomber Program*, 25-26, 324-25.
15. Moody, *Strategic Air Force*, 230.
16. Philip S. Meilinger, *Hoyt S. Vandenberg: The Life of a General,* 167-68; and Watson and Trest, "Framing Air Force Missions," 403-04.
17. Ltr, Gen. Muir S. Fairchild, Vice Chief of Staff, to Deputy Chief of Staff, Operations, 10 November 1949, sub: Acceleration of Air Defense Programs, folder General Correspondence, November 1949, box 1, Papers of Gen. Muir S. Fairchild, U.S. Air Force [hereafter Fairchild Papers], LC.
18. Wayne Thompson, "The Air War Over Korea," chap. 13 in *Winged Shield, Winged Victory*, Vol. II, 50-51.
19. Although not indicating that atomic bombs would be used, only that they would be available, a JCS planning document of March 1946 in the series code-named Pincher was the first indication that the United States would employ a strategic air offensive against the Soviet Union should war occur. In December 1947, another JCS planning study (Charioteer) was the first in which a nuclear air offensive was the central feature. The first war plan approved by the JCS that called for using atomic bombs in a strategic air offensive was Halfmoon (May 1948). For the evolution of the use of the atomic bomb and the strategic air offensive in JCS and Air Force war planning, see Steven T. Ross, *American War Plans, 1945–1950*, passim; Moody, *Strategic Air Force*, 114, 135-43, 146-49, 168, 171-73, 198-202, 287-89, 307-12; and Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 83-91.
20. Meilinger, *Vandenberg*, 194-95; David S. Sorenson, *The Politics of Strategic Aircraft Modernization*, 13-14, 38; and Stephen L. McFarland, *A Concise History of the U.S. Air Force*, 41.

21. In 1949, the Navy deployed two aircraft capable of carrying a nuclear weapon and flying from the deck of a carrier—a modified patrol bomber, the Lockheed P2V–3C, and the North American AJ–1 Savage. See chap. 7.
22. David Alan Rosenberg, "U.S. Nuclear Stockpile, 1945 to 1950," *Bulletin of the Atomic Scientists* 38, no. 5 (May 1982): 26.
23. Richard B. Rhodes, *Dark Sun: The Making of the Hydrogen Bomb*, 495; and Chuck Hansen, *U.S. Nuclear Weapons: The Secret History*, 147.
24. Jacob Neufeld, *Ballistic Missiles in the United States Air Force, 1945–1960*, 73, 94; McFarland, *Concise History*, 43; and Moody, *Strategic Air Force*, 355. Every nuclear weapons-capable bomber deployed by the Air Force through 1953—B–29, B–45, B–50 (a derivative of the B–29), B–36, and the all-jet B–47 had been designed before the detonation of the first atomic bomb in July 1945 and required modification to carry the weapon. The B–52 was the first Air Force bomber designed from the start to carry atomic bombs; its development began in 1946 and it entered service in 1955. See Moody, *Strategic Air Force*, 130.
25. Table 6 (Nuclear Weapons Stockpile, 1945–1960), in Robert J. Watson, *Into the Missile Age, 1956–1960*, 457. See also Rosenberg, "Nuclear Stockpile," 26; and Moody, *Strategic Air Force*, 121, 126.
26. Moody, *Strategic Air Force*, 149.
27. Table 6 (Nuclear Weapons Stockpile, 1945–1960), in Watson, *Missile Age*; Rosenberg, "Nuclear Stockpile," 26; Moody, *Strategic Air Force*, 214; and Trest and Watson, "Framing Air Force Missions," 425.
28. Moody, *Strategic Air Force*, 60, 202.
29. Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 86.
30. Neufeld, *Ballistic Missiles*, 60, 64.
31. For the B–45, see Marcelle Size Knaack, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems*, Vol. II, *Post–World War II Bombers, 1945–1973*, 78-81; and for the F–84G, see the same author's *Encyclopedia of U.S. Air Force Aircraft and Missile Systems*, Vol. I, *Post–World War II Fighters, 1945–1973*, 36. See also Walton S. Moody and Warren Trest, "The Air Force as an Institution," chap. 13 in *Winged Shield, Winged Victory*, Vol. II, 103.
32. Transcript of Aircraft Industry Conference, 20 September 1945, 23.
33. Neufeld, *Ballistic Missiles*, 8, 26-33, 48, 57, 59, 62.
34. Ibid., 48-49.
35. Ibid., 36-37, 66, 70, 74-76, 87.
36. Memo, Roswell L. Gilpatric, Under Secretary of the Air Force, for the New Secretary and Under Secretary of the Air Force, 31 December 1952, 12, folder 321.1, Organization and Policy, box 12, entry 10, RG 341 [italics added].
37. For excellent discussions of the origins, development, and impact of jet-turbine technology on the Air Force from World War II through the Korean War, see James O. Young, "Riding England's Coattails: The Army Air Forces and the Turbojet Revolution," and Richard P. Hallion, "The Air Force and the Supersonic Breakthrough," both in *Technology and the Air Force: A Retrospective Assessment*, ed. Jacob Neufeld, George M. Watson, Jr., and David Chenowith, 3-39 and 49-73.
38. Memo, Gen. Nathan F. Twining, Chief of Staff, U.S. Air Force, for Admiral Radford [Admiral Arthur W. Radford, chief of naval operations], 6 April 1954, folder Ready File, Gen. Twining, 1954, box 120, Papers of Gen. Nathan F. Twining, U.S. Air Force [hereafter Twining Papers], LC.
39. *Splendid Vision, Unswerving Purpose: Developing Airpower for the United States Air Force During the First Century of Powered Flight*, 109.
40. Thomas A. Julian, "The Origins of Air Refueling in the United States Air Force," *Technology and the Air Force*, 75-99.
41. Knaack, *Post–World War II Bombers*, 121.
42. Julian, "Air Refueling," 91-92; and Moody, *Strategic Air Force*, 267-68, 419-20.

43. Ltr, David T. Griggs to James E. Lipp, 27 September 1951, folder 095.1, RAND Corporation, box 4, entry 10 (Decimal Correspondence of the Special Assistant to the Chief of Staff Relating to the Organization of Research and Development Activities), RG 341.
44. Memo, Lt. Col. L. C. E. Urquhart, Acting Chief, Electronics Division; Directorate of Research and Development; Office, Deputy Chief of Staff, Development; Headquarters, U.S. Air Force, for Lt. Col. Walkowicz [Lt. Col. Theodore Walkowicz, executive, Office, Special Assistant to the Chief of Staff], 3 October 1952, sub: Utilization of Transistors in USAF Equipments, folder 360.2, Control and Communication Systems, box 13, entry 10, RG 341. The military, especially the Army Signal Corps, played a key role in transistor development. See Thomas J. Misa, "Military Needs, Commercial Realities, and the Development of the Transistor, 1948–1958," in *Military Enterprise and Technological Change: Perspectives on the American Experience*, ed. Merritt Roe Smith, 253-87.
45. For the origins of the Scientific Advisory Group and the *Toward New Horizons* study, see Michael H. Gorn, "The Marriage of Science to Air Power," introduction to *Prophecy Fulfilled: "Toward New Horizons" and Its Legacy*, ed. Michael H. Gorn, 1-16; and Michael H. Gorn, *Harnessing the Genie: Science and Technology Forecasting for the Air Force, 1944–1986*, 11-58. For the Arnold/von Karman relationship, see Dik A. Daso, *Architects of Air Supremacy: General Hap Arnold and Dr. Theodore von Karman*.
46. At first the Scientific Advisory Board did not have a military director per se; the deputy chief of air staff for research and development served as liaison between the board and the Air Staff, and the board submitted its reports to him. Beginning in 1948, the board was assigned a military director and sent its reports directly to the chief of staff. See Thomas A. Sturm, *The USAF Scientific Advisory Board: Its First Twenty Years, 1944–1964*, 14-26.
47. Neufeld, *Ballistic Missiles*, 74-78.
48. Martin J. Collins, *Cold War Laboratory: RAND, the Air Force, and the American State, 1945–1950*, 30-54, 80-84, 112-61.
49. Ibid., 156-62.
50. In 1946–1948 alone, RAND published almost 100 reports. Ibid., 146.
51. Ibid., 162-212, especially 201-12.
52. Ibid., 219-21; Fred Kaplan, *The Wizards of Armageddon*, 85-110; and Gregg Herken, *Counsels of War*, 88-94. Authored by A. J. Wohlstetter, F. S. Hoffman, R. J. Lutz, and H. S. Rowen, *Selection and Use of Strategic Air Bases* (RAND R–266), was published in April 1954.
53. See David A. Hounshell's insightful article, "The Medium is the Message, or How Context Matters: The RAND Corporation Builds an Economics of Innovation, 1946–1962," in *Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After,* ed. Agatha C. Hughes and Thomas P. Hughes, 255-310.
54. Office of the Command Historian, Air Research and Development Command, United States Air Force, *History of the Air Research and Development Command, 23 January 1950–30 June 1951*, Vol. I., *Narrative*, 24, microfilm roll K 2834, Air Force History Support Office [hereafter AFHSO], Bolling Air Force Base, Washington, D.C.
55. Collins, *Cold War Laboratory*, 32.
56. Not long after arguing the case for separation with Arnold and other AAF leaders, Bowles began advising General of the Army Dwight D. Eisenhower, the Army's new chief of staff, to reorganize the War Department General Staff along similar lines. See chap. 4.
57. Wolk, *Struggle for Air Force Independence*, 131.
58. Meilinger, *Vandenberg*, 64.
59. As part of the Air Staff reorganization in the fall of 1947, the assistant chiefs of staff became deputy chiefs of staff.
60. "Eyes Only" memorandum for General Spaatz, 22 July 1947, folder Office of the Secretary of the Air Force, box 58, Vandenberg Papers, LC. The tone and content of the memorandum suggest that its author may have been Symington (then the assistant secretary of war for air) or perhaps his top assistant, Eugene M. Zuckert, who would become the assistant secretary of the

Air Force for management when the service became independent in September 1947.
61. Spaatz, *Report of the Chief of Staff*, 30 June 1948, 43.
62. Transcript of informal remarks of Gen. Hoyt S. Vandenberg to the Scientific Advisory Board, 11 July 1949, 7, folder Research and Development, 1948–1949–1950, box 4, Fairchild Papers, LC; and Michael H. Gorn, *Vulcan's Forge: The Making of an Air Force Command for Weapons Acquisition (1950–1985)*, Vol. I, *Narrative*, 5.
63. "Eyes Only" memorandum for General Spaatz, 22 July 1947.
64. Department of the Air Force, *Report of the Secretary of the Air Force to the Secretary of Defense for Fiscal Year 1948*, 290-91.
65. There are several accounts of these events; this study relies principally upon Gorn, *Vulcan's Forge*, Vol. I, 5-17. The others, in reverse chronological order of their appearance are: Neil Sheehan, *A Fiery Peace in a Cold War: Bernard Schriever and the Ultimate Weapon*, 126-28; Stephen B. Johnson, *The United States Air Force and the Culture of Innovation, 1945–1965*, 36-39; Donald Ralph Baucom, "Air Force Images of Research and Development and Their Reflections in Organizational Structure and Management Policies," Ph.D. diss., University of Oklahoma, 1976, 116-73; Sturm, *Scientific Advisory Board*, 30-35; Ethel M. De Haven, *History of the Separation of Research and Development from the Air Materiel Command*, Vol. I, 51-82, microfilm roll 23716, AFHSO; and *History of the Air Research and Development Command, 23 January 1950–30 June 1951*, Vol. I, *Narrative*, 28-49.
66. "Lieutenant General Donald Leander Putt," U.S. Air Force Official Website, Biographies Database, http://www.af.mil/information/bios/bio.asp?bioID=6829 (retrieved 21 July 2011); and "General James Harold Doolittle," U.S. Air Force Official Website, Biographies Database, http://www.af.mil/information/bios/bio.asp?bioID=5249 (retrieved 21 July 2011).
67. For Schriever, see the biography by Neil Sheehan cited above. Other members of the "Young Turks" were Col. William A. Sheppard, Lt. Col. James Dempsey, Lt. Col. Peter Schenk, Lt. Col. Theodore F. Walkowicz, Maj. Vincent T. Ford, and Maj. Ralph J. Nunziato.
68. *History of the Air Research and Development Command, 23 January 1950–30 June 1951*, Vol. I, *Narrative*, 38-45; Baucom, "Images of Research and Development," 116-17, 133, 135-37, 157-65; Gorn, "*Vulcan's Forge*," 9-10, 12-15; and Johnson, *Culture of Innovation*, 36, 38. The key contemporary documents containing criticisms of the Air Force's R&D program are: Memo, Brig. Gen. Donald L. Putt, Military Director, Scientific Advisory Board, Office of the Chief of Staff, for the Chief of Staff, USAF, 24 May 1949, sub: Need for More Emphasis on USAF Research and Development Activities, folder Research and Development, 1948–1949–1950, box 4, Fairchild Papers, LC; Report of a Special Committee of the Scientific Advisory Board to the Chief of Staff, USAF (*Research and Development in the United States Air Force*), September 1949, folder Research and Development, box 120, Twining Papers [hereafter Scientific Advisory Board report, September 1949], LC; and Air University Study (*Research and Development in the United States Air Force*), 18 November 1949, folder 319.1, Air University Report, box 4, entry 377A (Office of the Deputy Chief of Staff, Materiel; Executive Office; Administrative Branch; General Decimal File, 1948–1952), RG 341 [hereafter Air University report, November 1949].
69. Johnson, *Culture of Innovation*, 36; Gorn, *Vulcan's Forge*, 7, 9, 14; Baucom, "Images of Research and Development," 117-20; W. D. Putnam, *The Evolution of Air Force System Acquisition Management*, R-868-PR, 3-4; and De Haven, *History of the Separation of Research and Development from the Air Materiel Command*, Vol. I, 62-63.
70. Lt. Gen. Laurence C. Craigie, address to the board of directors of the Air Force Association and to Air Force veterans in the 83d Congress, Bolling Air Force Base, Washington, D.C., 6 February 1953, 5, folder 350.1, Speeches, box 18, entry 10, RG 341.
71. Cover ltr, Theodore von Karman, Chairman, Scientific Advisory Board, to Gen. Hoyt S. Vandenberg, 21 September 1949, Scientific Advisory Board report, September 1949.
72. Cover ltr, Gen. George C. Kenney, Commander, Air University, to Gen. Hoyt S. Vandenberg, 19 November 1949, Air University report, November 1949.
73. Johnson, *Culture of Innovation*, 36.

74. Baucom, "Images of Research and Development," 65, 173.
75. Gorn, *Vulcan's Forge*, 26. Neil Sheehan presents a similarly one-sided view of AMC, describing the command as focused "on logistics and on quantity over quality" and its atmosphere as "stultifying." See *Fiery Peace*, 126.
76. Statistical Analysis Section, Plans Office, R&D Group, Logistics Division, U.S. Army General Staff, table (Department of Defense Research and Development Allocations, FY 1944–FY 1951), 8 November 1948, folder Research and Development, FY 1948–FY 1949, box 133, entry 26, RG 335; and minutes, USAF Aircraft and Weapons Board meeting, 20 August 1947, folder Verbatim Minutes, First Meeting, USAF Aircraft and Weapons Board, Second Day, 20 August 1947, 123, box 181, entry 190 (Deputy Chief of Staff, Development; Director of Requirements; Executive Office; Mail and Records Branch; First Aircraft and Weapons Board, Subject File, 1947–1948), RG 341.
77. Minutes, USAF Aircraft and Weapons Board meeting, 20 August 1947, 123.
78. Ltr, W. Stuart Symington to James E. Webb, Director, Bureau of the Budget, 16 December 1947, folder Secretary of the Air Force (1), box 263, Papers of Gen. Carl A. Spaatz, U.S. Air Force [hereafter Spaatz Papers], LC. In FY 1949, the Air Force finally received $218 million for R&D. See table (Research and Development Amounts Requested of Congress and Amounts Appropriated), 9 June 1953, atch to memo, W. H. Mautz, Director, Economic and Security Estimates Division, OSD, for Gordon Nease, Senate Appropriations Committee, 11 June 1953, sub: Budget Requests and Appropriations for Research and Development, folder Revised FY 1954 Budget, box 7, Budget Files, FY 1954, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO.
79. Memo, W. Stuart Symington for Secretary Forrestal, 16 December 1947, folder Secretary of the Air Force (1), box 263, Spaatz Papers, LC.
80. See chap. 2; and "Summary of R&D Programs, NSC 68" (undated, but late October 1950), folder NSC 68 Programs, box 53, Vandenberg Papers, LC.
81. Transcript of informal remarks of Gen. Hoyt S. Vandenberg to the Scientific Advisory Board, 11 July 1949, 4, folder Research and Development, 1948–1949–1950, box 4, Fairchild Papers, LC; Scientific Advisory Board report, September 1949, sec. VI–9; memo, Brig. Gen. Marshall S. Roth, Assistant for Development Programming, Office, Deputy Chief of Staff for Development, for Mr. Griggs, 9 April 1952, sub: FY 1953 Research and Development Budget Levels, folder 120.1, Funds, box 12, entry 10, RG 341; memo, R. L. Gilpatric, Under Secretary of the Air Force, and Lt. Gen. Laurence C. Craigie, Deputy Chief of Staff for Development, for Chairman, Research and Development Board, 13 May 1952, Assumptions and Guidelines for the Preparation of FY 1954, Research and Development Budgets, ibid.; and memo, David T. Griggs, Chief Scientist, USAF, for Dr. Whitman, Chairman, Research and Development Board, 18 June 1952, sub: Notes on Our Discussion of 11 June 1952, folder 312.4, Correspondence, Personal, D. T. Griggs, ibid.
82. Minutes, USAF Aircraft and Weapons Board meeting, 27 January 1948, 95, folder Verbatim Minutes, Second Meeting, USAF Aircraft and Weapons Board, First Day, 27 January 1948, box 183, entry 190, RG 341.
83. Transcript of Air Staff meeting, 3 January 1950, DeHaven, *History of the Separation of Research and Development from the Air Materiel Command,* Vol. IV, 23-24.
84. Minutes, USAF Aircraft and Weapons Board meeting, 27 January 1948, 94.
85. RDB 106.1/3 ("Additional Comments and Suggestions," app. B to Barker Committee Report), 14 March 1951, folder 334.3, Research and Development Board, box 7, entry 10, RG 341.
86. Minutes, USAF Aircraft and Weapons Board meeting, 27 January 1948, 95.
87. Ltr, Lt. Gen. E. W. Rawlings, Commanding General, Air Materiel Command, to Deputy Chief of Staff, Materiel, 6 November 1951, sub: Method of Financing Engineering and Development, folder 120.1, Funds, box 4, entry 10, RG 341 [italics added]. See also ltr, Lt. Gen. B. W. Chidlaw, Commanding General, Air Materiel Command [Rawlings' immediate

predecessor], to Lt. Gen. J. H. Doolittle (Retired), 29 June 1951, sub: Cross Funding Air Materiel Command and Air Research and Development Command; and ltr, J. H. Doolittle, Special Assistant to the Chief of Staff, to Maj. Gen. St. Clair Street, Deputy Commanding General, Air Materiel Command, 12 July 1951: both ibid.
88. DeHaven, *History of the Separation of Research and Development from the Air Materiel Command*, Vol. I, 50-51.
89. Memo, Trevor Gardner, Special Assistant to the Secretary of the Air, for Secretary Talbott [Secretary of the Air Force Harold E. Talbott], 31 March 1953, folder 360.11, Atomic Energy Program, box 20, entry 10, RG 341; and Brown, *Flying Blind*, 194-96.
90. Briefing (The USAF Aircraft and Weapons Board) for the Scientific Advisory Board, undated, folder Organization and Historical Items, box 181, entry 190, RG 341; and Air Force Regulation 20-10 (USAF Aircraft and Weapons Board), 21 November 1947, encl. 1 to memo, Maj. Gen. Carl A. Brandt, Chief, Operational Requirements Division, Directorate of Training and Requirements, for General McKee [Maj. Gen. William F. McKee, assistant vice chief of staff], 16 June 1949, sub: Termination of the USAF Aircraft and Weapons Board, folder General Correspondence, August–September 1949, box 1, Fairchild Papers, LC.
91. The Air Force Council formulated Air Force objectives and policies; initiated, approved, and reviewed programs; and disseminated guidance to the Air Staff. Its members included the vice chief of staff, the assistant vice chief of staff, the deputy chiefs of staff, the comptroller, and the inspector general. See Watson, *Secretary of the Air Force*, 121.
92. In July 1951, the Aircraft and Weapons Board was reestablished, but at an organizational level below the deputy chiefs of staff; its job was to make recommendations regarding R&D and procurement to the Air Force Council.
93. Knaack, *Post–World War II Bombers*, 209-13.
94. Memo, W. Stuart Symington for General Spaatz, 29 January 1948, folder Secretary of the Air Force (1), box 264, Spaatz Papers, LC. See also, W. Stuart Symington, interview by James R. Fuchs, Washington, D.C., 29 May 1981, 24 (sec. 62). The interview is on file in the Harry S. Truman Library, Independence, Mo., and can be accessed at the Library's website, http://www.truman.library.org/oralhist/symton.htm.
95. Cited in Bud Baker, "Clipped Wings: The Death of Jack Northrop's Flying Wing Bombers," *Acquisition Review Quarterly* 8, no. 3 (Fall 2001): 212.
96. See memo, Under Secretary of the Air Force John A. McCone for Secretary Finletter, 15 August 1950, atch to memo, Col. Glen W. Martin, Executive, Office of the Secretary of the Air Force (dictated by Secretary of the Air Force Finletter), for Secretary Pace [Secretary of the Army Frank Pace, Jr.] and Secretary Matthews [Secretary of the Navy Francis P. Matthews], 17 August 1950, folder A1-A1-1, box 5, Op–00 Files (1950), Operational Archives Branch, Naval Historical Center, Washington, D.C.; ltr, McCone to J. H. Kindelberger, Chairman of the Board, North American Aviation, Inc., 1 September 1950, and ltr, Kindelberger to McCone, 15 September 1950: both in folder North American Aviation, 1950, box 17, entry 377A, RG 341; Watson, *Secretary of the Air Force*, 126-27; and Neufeld, *Ballistic Missiles*, 79-80
97. Johnson, *Culture of Innovation*, 36.
98. Ibid., 39.
99. DCS/Development Memorandum No. 37 (Air Force Development and Programming Procedures), 8 September 1950, atch to memo, Maj. Gen. Donald L. Putt, Assistant Deputy Chief of Staff, Development, for Brig. Gen. R. A. Grussendorf [executive to the chief of staff], 14 May 1951, folder Organization, box 55, Vandenberg Papers, LC; encl. to memo, Lt. Col. Peter J. Schenk, Executive, Office, Special Assistant to the Chief of Staff, for Mr. Doolittle, 12 May 1953, sub: Future Plans for AFCCS-SA [i.e., for the Office of the Special Assistant], folder 200.1, Personnel, box 17, entry 10, RG 341; Historical Division, Office of Information Services, Air Research and Development Command, United States Air Force, *History of the Air Research and Development Command, 1 January–31 December 1953*, Vol. I, *Narrative*, 364-67, microfilm roll K 2836, AFHSO; and Johnson, *Culture of Innovation*, 43.

100. See memo, Gen. N. F. Twining, Chairman, Air Force Council, for the Chief of Staff, 15 February 1952, sub: Development Planning Objectives, 1956–1960, folder Reading File, February 1952, box 56, Twining Papers, LC; and Brown, *Flying Blind*, 171.
101. Encl. to memo, Schenk for Doolittle, 12 May 1953.
102. Memo, Brig. Gen. Alfred R. Maxwell, Chief, Requirements Division, Assistant Chief of the Air Staff, G–3, for Assistant Chief of the Air Staff, G–3, 4 November 1946, sub: Mission of the Requirements Division, folder Organization and Historical Items, box 181, entry 190, RG 341.
103. Memo, W. Stuart Symington for the Under Secretary of the Air Force, and Chairman, Senior Officers Procurement Board, 11 July 1949, sub: Procedure of Senior Officers Procurement Board, folder Senior Officers Procurement Board, 1948–1949, box 4, Fairchild Papers, LC.
104. Mobilization Analysis Center, Graduate School of Business Administration, Harvard University, *Requirements Survey Report to the Munitions Board*, Pt. IV, *Department of the Air Force*, January–March 1951, 4, box 36, entry 218, RG 330.
105. Ltr, R. L. Gilpatric, Under Secretary of the Air Force, to Harold R. Boyer, Chairman, Aircraft Production Board, Office of Defense Mobilization, 14 November 1951, folder 312, Correspondence, box 40, entry 377A, RG 341. See also memo, R. L. Gilpatric for General Vandenberg, 26 October 1951, folder Official Reading File, October 1951, box 223, entry 23 (Office of the Administrative Assistant, Correspondence Control Division, General File by Organization and Subject, 1947–Jan. 1953; Assistant Secretary of the Air Force, Materiel, Jun. 1951–Oct. 1951, R. L. Gilpatric, Official Reading File, Jun. 1951–Aug. 1951), RG 340 (Records of the Office of the Secretary of the Air Force), Archives II; memo, R. L. Gilpatric for Secretary Lovett, 8 November 1951, sub: Air Force Troubles with CMP, folder CD 401.1, 1951, box 283, entry 199 (Confidential through Top Secret Subject Correspondence File, 1947–1953), RG 330; and W. S. Taylor, Staff History of the Office, Deputy Chief of Staff, Materiel, 1 Jul. 1951–31 Dec. 1951, ca. March 1952, 5-6, folder 314.7, Staff History of DCS/Materiel, 1 Jul. 1951 thru 31 Dec. 1951, box 52, entry 377A, RG 341.
106. Memo, William C. Foster, Deputy Secretary of Defense, for the Secretary of the Army, the Secretary of the Navy, the Secretary of the Air Force, 16 October 1952, folder 322, AMC, 1952, box 57, entry 377A, RG 341.
107. Memo, Maj. Gen. Edward W. Anderson, Assistant Deputy Chief of Staff, Comptroller, for Maj. Gen. Robert M. Lee, Director of Plans, Deputy Chief of Staff, Operations, 16 December 1952, sub: Establishment of Office for Review of Military Requirements; and memo, Maj. Gen. Robert M. Lee for Lt. Gen. Thomas D. White, Deputy Chief of Staff, Operations, 16 December 1952, sub: Establishment of Office for Analysis and Review of Requirements for Manpower, Materiel, Materials, and Facilities: both in folder Miscellaneous Actions and Policy Papers, box 119, Twining Papers, LC.
108. Johnson, *Culture of Innovation*, 47-48; and chart 14 (Conventional Aircraft Development and Procurement), Combat Ready Aircraft Presentation to Deputies Council, 30 April 1951, folder 452.3, Status of Aircraft, box 10, entry 10, RG 341.
109. Brown, *Flying Blind*, 56-58.
110. Alfred Goldberg, "Equipment and Services," in *Men and Planes*, Vol. 6, *The Army Air Forces in World War II*, 201; Jacob Vander Meulen, *Building the B–29*, 21, 86; and Roger E. Bilstein, *The Enterprise of Flight: The American Aviation and Aerospace Industry*, 75-76.
111. Lawrence R. Benson, *Acquisition Management in the United States Air Force and its Predecessors*, 18; and Johnson, *Culture of Innovation*, 48.
112. Johnson, *Culture of Innovation*, 48-49.
113. Combat Ready Aircraft Presentation to Deputies Council, 30 April 1951, folder 452.3, Status of Aircraft, 10-1, box 10, entry 10, RG 341. Postproduction modification centers were not reestablished until the Korean War.
114. Presentation on Materiel Deficiencies Which Limit the Combat Capabilities of the Strategic Air Command, 4 January 1950, 7, box 105, Papers of Gen. Curtis E. LeMay, U.S. Air

Force [hereafter LeMay Papers], LC.
115. AMC Presentation on Materiel Deficiencies, 4 Jan 1950, ibid.
116. Ltr, Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel, to Lt. Gen. Ennis C. Whitehead, Commanding General, Continental Air Command, 25 January 1950, with note "Ennis" to "K.B.," 3 January 1950, folder 452.1, 1950, box, 29, entry 377A, RG 341.
117. Johnson, *Culture of Innovation*, 50-51. Twining became vice chief of staff in October 1950 following Fairchild's death the previous March. In the interim, Gen. Lauris Norstad served as acting vice chief of staff.
118. "Combat Ready Aircraft: An Air Force Staff Study Prepared by Deputy Chief of Staff, Development," April 1951, 9-12, 22-25, folder T-10.05, file 168.7265-236, 1951–1952, Papers of Maj. Gen. Marvin C. Demler, U.S. Air Force [hereafter Demler Papers], United States Air Force Historical Research Agency [hereafter AFHRA], Maxwell Air Force Base, Ala.; and Historical Division, Office of Information, Air Research and Development Command, United States Air Force, *History of the Air Research and Development Command, 1 July 1959–31 December 1959*, Vol. I, III-167-68 (note 13), file K243.01, AFHRA.
119. Ltr, Maj. Gen. Donald L. Putt, Vice Commander, Air Research and Development Command, to Commanding General, Wright Air Development Center, 8 December 1952, sub: General Policy Guidance on Use of a Single Prime Contractor for Development of a Complete Weapon System, folder T-10.06, file 168.7265-237, 1952–1954, Demler Papers, AFHRA.
120. I am indebted to historian Stephen B. Johnson not only for bringing to light the "Combat Ready Aircraft" study and assessing its significance but also for his many other insights into the nature and course of Air Force research and development in the decade and a half following World War II.
121. In 1952, a letter from the Air Staff to the Air Materiel Command identified the major elements of an Air Force weapon system as the airframe, propulsion, guidance and control, armament, ground support, and general support. See ltr, Col. N. D. Sillin (By Command of the Chief of Staff), Chief, Program Division, Assistant for Materiel Program Control, Office, Deputy Chief of Staff, Materiel, to Commanding General, Air Materiel Command, 19 September 1952, sub: Programming for Weapons Systems, folder 470, Ordnance, 1952, box 54, entry 377A, RG 341.
122. Donald R. McVeigh and Robert L. Perry with Warren E. Greene, *The Development of the F–102 Aircraft (through December 1954)*, Vol. I, 13-14, microfilm roll K 2924, AFHSO.
123. Minutes, USAF Aircraft and Weapons Board meeting, 27 January 1948, 24-26.
124. McVeigh and Perry, *Development of the F–102*, Vol. I, 17-18.
125. Ltr, Putt to Commanding General, Wright Air Development Center, 8 December 1952.
126. My discussion of the weapon system project office is based on Gorn, *Vulcan's Forge*, 28-33; Johnson, *Culture of Innovation*, 48-51; and Putnam, *Air Force System Acquisition Management*, 2-5.
127. Ltr, Gen. Hoyt S. Vandenberg to Commanding General, Air Research and Development Command; Commanding General, Air Materiel Command; and Commanding General, Air Proving Ground Command; 16 October 1952, sub: Qualitative Changes to Aircraft and Equipment Programmed for Production, folder 452.1 thru 486.7, 1952, box 58, entry 377A, RG 341.
128. McVeigh and Perry, *Development of the F–102*, Vol. I, 19-20; and Knaack, *Post–World War II Fighters*, 159.
129. Report of the Panel on Piloted Aircraft to the Committee on Aeronautics, Research and Development Board: The Fighter Aircraft Development Program, 1 April 1952, 22, folder CD 452.01, 1952, box 383, entry 199, RG 330; and *History of the Air Research and Development Command, 1 January–31 December 1953*, Vol. I, *Narrative*, 572.
130. Knaack, *Post–World War II Fighters*, 159-60.
131. L. L. Johnson, *The Century Series Fighters: A Study in Research and Development*, 7.
132. *History of the Air Research and Development Command, 1 January–31 December 1953*, Vol.

I, *Narrative*, 579-80. In April 1953, a Research and Development Board report described the advanced nature of the F–102's controlled intercept system: "[I]t is almost completely automatic, being directed to the target area by ground control, after which the airborne fire-control system takes over control for the final interception. The high degree of automaticity is especially necessary because of the difficulty of intercepting high-speed aircraft. The small time interval between detection and interception requires a large amount of automatic computing and control equipment. This equipment is very complex . . . ." See Research and Development Board, "Status Report on the Aeronautical Research and Development Program," 17 April 1953, 3, folder 2 (RDB-AR-100), box 431, entry 341 (Records of the Research and Development Board), RG 330.
133. Johnson, *Century Series Fighters*, 7-8.
134. The Convair design grew out of the company's experimental XF–92A, the world's first delta-wing (although subsonic) aircraft that had first flown in September 1948. The Republic entry, considered too advanced and not likely to meet the deployment objective, eventually became the XF–103. The Lockheed proposal was dropped entirely, but only after the firm had received a contract to develop a long-range transport aircraft. See Knaack, *Post–World War II Fighters*, 159-60; and McVeigh and Perry, *Development of the F–102*, Vol. I, 28.
135. McVeigh and Perry, *Development of the F–102*, Vol. I, 26.
136. Knaack, *Post–World War II Fighters*, 161; McVeigh and Perry, *Development of the F–102*, Vol. I, 29-34; and Frederick A. Alling, *The F–102A Airplane, 1950–1956*, Vol. IV, *History of the Air Materiel Command, 1 July–31 December 1956*, 5-6, microfilm roll 23704, AFHSO. First designated the F–102B, the "ultimate" interceptor finally entered service in late 1959 as the F–106 Delta Dart.
137. Knaack, *Post–World War II Fighters,*162; and McVeigh and Perry, *Development of the F–102*, Vol. I, 43-44.
138. Alling, *The F–102A Airplane, 1950–1956*, 19.
139. Alling, *The F–102A Airplane, 1950–1956*, 17-18.
140. Johnson, *Century Series Fighters*, 13; and Knaack, *Post–World War II Fighters*, 165.
141. Hallion, "Supersonic Breakthrough," *Technology and the Air Force*, 49-73. In the 1940s, transonic meant speeds from Mach (the speed of sound) .75–1.25; supersonic spanned Mach 1.25–Mach 5 (Hallion, 69, note 1).
142. Knaack, *Post–World War II Fighters*, 163-64; McVeigh and Perry, *Development of the F–102*, Vol. I, 46-53; and Alling, *The F–102A Airplane, 1950–1956*, 20-23. The F–102A did not become operational until April 1956, nearly three years after the Air Force expected production to begin when it awarded Convair the contract.
143. Alling, *The F–102A Airplane, 1950–1956*, 10-11.
144. Johnson, *Century Series Fighters*, 20, 25.
145. Brown, *Flying Blind*, 19-24, 68-69, 105-06, 147-53, 157-62, 190-92, 338-39.
146. Johnson, *Culture of Innovation*, 52.
147. A further incentive for design changes existed in the nature of cost-reimbursement or fixed-price contracts in which contract changes usually meant adding dollars to contracts authorizing additional costs and profits associated with the changed work to be performed.
148. E. Clifford Snyder, *Production Problems During the Air Force Build-Up, 1950–1954*, Vol. I, *Narrative*, 31-32, 60-61, microfilm roll 23709, AFHSO.
149. Memo, Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel, for General Twining, 28 March 1951, sub: Design and Configuration Freeze—Production and Inventory Aircraft, folder Reading File, April 1951(1), box 54, Twining Papers, LC.
150. Msg, AFCVC [Air Force vice chief of staff] 59210 to CGAMC [commanding general, Air Materiel Command], Wright-Patterson AFB, Dayton, Ohio, 11 April 1951, sub: Freezing the Design of Current Production Aircraft; and msg, AFCVC 59267 to CGAMC, Wright-Patterson AFB, Dayton, Ohio, 12 April 1951, sub: Configuration Freeze on Aircraft in the Air Force Inventory: both atch to memo, Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel,

for General Twining, 25 April 1951, sub: Configuration Freeze on Aircraft in the Air Force Inventory, folder Reading File, April 1951 (3), ibid. Later, Twining delegated approval authority for these changes to the commanding general, Air Materiel Command. See staff summary sheet, Maj. Gen. D. L. Putt, Acting Deputy Chief of Staff for Development, for AFCVC, 2 July 1951, sub: Aircraft Modification, folder 452.1, Jul. thru Dec. 1951, box 49, entry 377A, RG 341. The freeze contained loopholes. The Air Force, for example, could maintain that an increase in system performance resulting from a design change would ensure aircraft and crew safety.

151. Memo, McKee [Maj. Gen. William F. McKee, assistant vice chief of staff] for General Twining, 29 March 1951, atch to memo, Wolfe for Twining, 28 March 1951, ibid.

152. Staff summary sheet, Maj. Gen. D. L. Putt, Acting Deputy Chief of Staff for Development, for AFCVC, 2 July 1951, sub: Aircraft Modification, folder 452.1, Jul. thru Dec. 1951, box 49, entry 377A, RG 341.

153. Memo, Gen. Hoyt S. Vandenberg, Chief of Staff, for the Deputy Chief of Staff for Development, 14 January 1952, folder 452.1, Aircraft, Box 15, entry 10, RG 341. Identical memoranda were sent to the deputy chief of staff, materiel; the deputy chief of staff, operations; the deputy chief of staff, personnel; and the comptroller. Vandenberg also authorized the deputy chief of staff for materiel to prescribe the administrative procedures necessary to control changes. The copy of the chief of staff's memo cited here contains the following handwritten note by "W" (Lt. Col. Theodore F. Walkowicz, Doolittle's assistant) and clearly reflects how suspicious some developers were about the motives of producers: "DCS/M could: 1. Change ARDC-AMC setup at will, 2. Set up an engineering organization of his own, to affect or pass on changes, 3. Redelegate this authority."

154. Ltr, H. R. Boyer, Chairman, Aircraft Production Board, to Charles E. Wilson, Director, Office of Defense Mobilization, 8 January 1952, sub: Control of "Changes" in Aircraft Design, folder Reading File, January 1952, box 56, Twining Papers, LC.

155. Staff summary sheet, Col. J. L. Zoeckler, Deputy Chief, Engineering Division, Directorate, Procurement & Production Engineering, Office, Deputy Chief of Staff, Materiel, for Director of Research and Development, DCS/D (Attn: Gen. Putt), 3 May 1951, sub: Model Improvement Program for Production Aircraft, folder 452.3, Status of Aircraft, box 10, entry 10, RG 341.

156. Holley, *Buying Aircraft*, 535.

157. Encl. to staff summary sheet, Zoeckler for Director of Research and Development, DCS/D (Attn: Gen. Putt), 3 May 1951.

158. Headquarters Operating Instruction 55-4, 6 November 1951. See staff summary sheet, Maj. Gen. M. R. Nelson, Director of Requirements, Office, Deputy Chief of Staff, Development, for the Vice Chief of Staff, 18 October 1951, sub: Model Improvement Program for Production and In-Service Aircraft and Equipment, folder 452.1, Aircraft, box 44, entry 377A, RG 341; and memo, Col. Whitmell T. Rison, Director, Procurement & Production Engineering, Office, Deputy Chief of Staff, Materiel, for General Cook, 8 January 1952, sub: Configuration Change in Production Aircraft, folder 452.1 thru 486.7, 1952, box 58, entry 377A, RG 341.

159. Ltr, Gen. Hoyt S. Vandenberg to Commanding General, Air Research and Development Command; Commanding General, Air Materiel Command; and Commanding General, Air Proving Ground Command; 16 October 1952, sub: Qualitative Changes to Aircraft and Equipment Programmed for Production, ibid.

160. Alling, *The F–102A Airplane, 1950–1956*, 7.

161. Ltr, Gen. Curtis E. LeMay, Commanding General, Strategic Air Command, to Gen. Nathan F. Twining, Vice Chief of Staff, 3 October 1952, folder Reading File, December 1952, box 58, Twining Papers, LC.

162. Ltr, Twining to LeMay, 20 November 1952, folder Twining, box 60, LeMay Papers, LC.

163. Ltr, LeMay to Twining, 4 December 1952, ibid.

164. Ltr, Twining to LeMay, 8 January 1953, ibid.

165. Ltr, LeMay to Twining, 17 January 1953, ibid., and ltr, Twining to LeMay, 6 February 1953, folder Reading File, February 1953, box 58, Twining Papers, LC.
166. Statement of Thomas K. Finletter before the House of Representatives Committee on Appropriations, 30 January 1952, 12, folder Congressional Hearings, box 47, Vandenberg Papers, LC.
167. Suggested Remarks for General Twining, Joint Civilian Orientation Conference, 25 September 1952, 8, atch to memo, Col. Noel F. Parrish for General Twining, 22 September 1952, sub: Your Remarks at the Joint Civilian Orientation Conference, folder 2, box 15, series 4, Papers of Gen. Nathan F. Twining, Special Collections Branch, Robert F. McDermott Library, United States Air Force Academy, Colorado.

I. Sources: Donald L. Putt, interview by Dr. James C. Hasdorff, U.S. Air Force Oral History Program, 1-3 April 1974, Atherton, Calif., 1-28 (quotation, 19), 50-58, 187-89, 229-37, 248-49, file K239.0512-724, Air Force Historical Research Agency, Maxwell Air Force Base, Ala.; "Lieutenant General Donald Leander Putt," U.S. Air Force official website, Biographies Database, http://www.af.mil/information/bios/bio.asp?bioID=6829 (retrieved 21 July 2011); biographical profile, "Lieutenant General Donald L. Putt," in *Splendid Vision, Unswerving Purpose: Developing Airpower for the United States Air Force During the First Century of Powered Flight*, 319; Thomas A. Sturm, *The USAF Scientific Advisory Board: Its First Twenty Years, 1944–1964*, 108-13; Michael H. Gorn, *Harnessing the Genie: Science and Technology Forecasting for the Air Force, 1944–1986*, 48-50, 92-93; and J. D. Hunley, "Minuteman and the Development of Solid-Rocket Launch Technology," chap. 6 in *To Reach the High Frontier: A History of U. S. Launch Vehicles*, ed. Roger D. Launius and Dennis R. Jenkins, 251, 268, 272.

CHAPTER VI

The Air Force and the Aircraft Manufacturing Industry

The conferees left the dock at 7th Street & Maine Avenue in the nation's capital on board the privately owned *District of Columbia* early in the evening of 13 May 1947. The next day, after an all-night cruise south on the Potomac River and the Chesapeake Bay, the passengers debarked at Old Point Comfort and were transported to laboratories of the National Advisory Committee for Aeronautics located at Langley Army Air Field just north of Hampton, Virginia. From there, the group proceeded to The Inn at Williamsburg for three days of meetings on problems of mutual interest to the military and civil aviation agencies of the government and to the aircraft manufacturing and air transport industries. Funded by the Aircraft Industries Association, the conference was the second of what would become an annual affair; the first had been held at the same venue the previous July.[1]

Almost half of the nearly 100 who accepted invitations to attend the 1947 meeting were generals and admirals, including General Carl Spaatz, commanding general of the Army Air Forces (soon to be the first chief of staff of the Air Force) and Admiral D. C. Ramsey, the vice chief of naval operations.[2] Although not as numerous as the uniformed military, several civilian government leaders were also present. Among them were the under secretary of the Army, the assistant secretary of the Navy for air, the assistant secretary of commerce, the administrator of civil aeronautics, the chairman of the Civil Aeronautics Board, the chairman of the Army-Navy Munitions Board, and two high-level State Department officials.[3]

With all 20 members of its board of governors attending, the Aircraft Industries Association was represented in force at Williamsburg. Because of the industry's spectacular growth during World War II and air power's contribution to victory, many of the board members were well known to the American public and constituted the most recent incarnation of the nation's long line of industrial titans. Among them, all chairmen of the board or presidents of their companies, were William M. Allen of Boeing, Harry Woodhead of Consolidated-Vultee

Aircraft (Convair), Guy W. Vaughan of Curtiss-Wright, Donald W. Douglas, Sr., of Douglas Aircraft, J. Carlton Ward, Jr., of Fairchild Engine & Airplane, Robert E. Gross of Lockheed Aircraft, J. H. "Dutch" Kindelberger of North American Aviation, LaMotte Cohu of Northrop Aircraft, Mundy I. Peale of Republic Aviation, and H. M. Horner of United Aircraft.[4]

The Williamsburg meeting was critical to the aircraft manufacturers; they considered their industry to be in a "state of crisis."[5] In terms of value of output, it had become the largest manufacturing industry in the world in 1944.[6] But three years later, aircraft manufacturing appeared to be in free fall; cumulative losses since the end of the war were nearly $100 million, and employment had plunged from 2,080,000 in 1944 to 192,000 in 1946.[7] Only the federal government, it seemed, could prevent a complete collapse.

In May 1948, within a year of the Williamsburg conference, in response to the recommendations of two government bodies and a threatening international environment, Congress came to the rescue of the aircraft industry, appropriating almost $3.2 billion for military aviation procurement and thereby reinvigorating both the industry and its alliance with the government that had flourished during World War II. In the interim, the Air Force, notably Stuart Symington, its civilian head, had sought to aid the industry through careful distribution of the service's procurement contracts. Despite the close association between the aircraft manufacturers and the Air Force, their chief customer, the relationship between the two was not without turbulence, as illustrated in this chapter by the bitter dispute between Boeing and the Air Force over responsibility for system integration in the acquisition of the B–47 strategic bomber, and by the industry's controversial practice of employing retired military officers.

INDUSTRY OVERVIEW

The aircraft industry's decline—anticipated at the end of World War II and well under way by the time industry representatives met with government officials in Williamsburg in the spring of 1947—continued unabated following the Virginia conference. By 1948, aircraft manufacturing had fallen to forty-fourth place by value of product among American industries—the same position it held in 1939.[8] In just over a decade, however, the industry would reclaim its top rank, becoming the largest single manufacturing employer in the country in 1959.[9] This dramatic turnabout owed much to the national security strategy that emphasized both permanent military preparedness and a reliance on technologically advanced aerial weapons. The armed services, especially the Air Force, were the industry's principal customers; other markets were for the most part secondary. Major changes in aerial warfare occurring during the 1950s would have far-reaching impacts on these companies. By the end of the decade, the missile was beginning to compete with the airplane in strategic importance, and outer space was emerging as a completely new operating environment. These developments transformed aircraft manufacturing into the aerospace industry.[10]

From the end of World War II through the 1950s, the key characteristics of the aircraft manufacturing industry reflected its close ties to the government. Most obvious was the industry's heavy dependence on government orders for military aircraft, along with its tendency to experience alternating periods of expansion and contraction that corresponded to fluctuations in the military budget. Another was aircraft manufacturing's ambiguous position in the American economic structure; it was not a public enterprise, but thanks to government subsidies it was not entirely private either. Finally, reflecting the quality not quantity orientation of U.S. security strategy, the industry was readily recognizable for its development and application of advanced technologies.

Without government purchase of its products, aircraft manufacturing would have been a second-tier industry. From 1948 through 1958, military aircraft and parts averaged three-fourths of total aircraft industry sales annually.[11] Although a percentage of these sales were with foreign countries, even in these instances the Department of Defense usually acted as the "principal salesman" and often the contracting agent for the aircraft manufacturers with other nations.[12]

Because government procurement tended to be sporadic, peaking during wartime or other emergencies and falling sharply as crises passed, a roller-coaster existence had typified much of aircraft manufacturing's history.[13] This up-and-down pattern was evident following World War II. In May 1947, in a speech at the Williamsburg conference, Robert E. Gross, president of Lockheed, noted that the companies that had built 96,000 military aircraft in 1944 made only about 1,300 in 1946.[14] From this postwar low, the number manufactured climbed to just over 2,100 in 1947 but did not exceed 2,700 in any year before 1951. The Korean War and the force levels authorized to support NSC 68, the policy statement calling for rearmament to meet the perceived Communist threat, resulted in a burst of production—5,055 military aircraft in 1951, 7,131 in 1952, and 8,978 in 1953. Thereafter production slid yearly, falling to fewer than 1,600 in 1961.[15] Some of the decline reflected reduced defense spending, some the rising cost and increasing capability of aircraft (the same results could be achieved with fewer planes), and some the shift from aircraft to missiles. The latter development caused uncertainty in the industry as it attempted to adjust to the transition beginning in the late 1950s.[16]

As might be expected, the peaks and valleys of government buying, combined with the overall decline in the number of aircraft orders, resulted in some rationalization in the industry. The number of firms specializing in military aircraft dropped from 16 to 11 from 1945 through the end of the 1950s.[17] This rationalization reflected companies leaving the industry or consolidating with others that remained.

Among the firms exiting aircraft manufacturing after World War II were two industry giants bearing famous names in American aviation history—the

Curtiss-Wright Corporation and the Glenn L. Martin Company. Curtiss-Wright, an industry leader before the war and fourth-ranked with respect to numbers of aircraft produced between 1940 and 1945, stopped manufacturing airframes in 1951 and built only jet engines and propellers thereafter until collapsing completely by the end of the decade. Some view the company's departure from the airframe business as largely a result of its neglect of research and development and subsequent failure to produce advanced designs.[18] Another explanation is that Curtiss-Wright, whether building airframes, engines, or propellers, lost favor with its principal customer, the Air Force, because it insisted on subsidized development and production even though the company's performance was less than the Air Force had reason to expect.[19]

Although it did not completely leave the industry like Curtiss-Wright, the Martin Company led a precarious existence following the war. Its six-jet XB–48 bomber lost out to Boeing's B–47, and the Air Force could not find use for the firm's XB–51 tactical bomber. With the failure of its designs to compete successfully in the commercial air transport field, Martin was close to bankruptcy by 1951. Production of the British-designed B–57 Canberra bomber for the Air Force and manufacture of the P5M patrol bomber for the Navy kept the company alive in military aircraft manufacturing in the 1950s. But these projects were not enough, and Martin ceased building aircraft in 1960, turning its attention completely to missiles, with which it had been involved since 1946.[20]

Consolidation—the other form of rationalization—did not occur frequently between World War II and the end of the 1950s. The only examples were the absorption in 1953 of Chase Aircraft Company by the Kaiser-Frazer Corporation, a shipbuilding and automobile manufacturing firm, and the voluntary merger of the larger Convair into the smaller General Dynamics Corporation (formerly Electric Boat) in 1954.[21] (By the mid-1970s, only eight prime contractors specialized in military aircraft; in 2000 only three remained—Lockheed Martin and Northrop Grumman, both the result of mergers in 1994, and Boeing, which had purchased McDonnell Douglas in 1997.)[22]

Several factors had worked against consolidation. One was Justice Department opposition. In 1946, Lockheed's Gross, a strong advocate of consolidation, considered uniting his company with Convair. Recommending that the Army Air Forces support the move, Maj. Gen. E. M. Powers, assistant chief of Air Staff for materiel, wrote Assistant Secretary of War for Air Symington that "the merger will provide a well-rounded out and strong organization which will probably be in a better position to produce military aircraft than would be the case if they would remain separate."[23] But the Justice Department blocked the plan. "You can imagine my amazement and disappointment," Gross wrote to a friend on the Harvard Business School faculty, "when . . . the Attorney General's office said that they were opposed to the proposed merger on the grounds that it would lessen competition and that it was in restraint of trade and tended toward a monopoly."[24] Other industry merger attempts failed because of the inherent difficulties associated with consolidating complex business enterprises.[25] Finally, many company founders, including Donald W. Douglas, Sr., Glenn L. Martin, and Jack Northrop, whose firms bore their names, naturally resisted merger because of the potential for loss of personal control and organizational identity.[26]

The men who had pioneered in aircraft manufacturing were innovators and risk takers—attributes of the capitalist entrepreneur. But their industry did not conform to the ideal model of a company operating in a competitive market economy. Frederic M. Scherer (along with Merton J. Peck, the author in 1962 of *The Weapons Acquisition Process,* a path-breaking analysis of the subject), commented that aircraft manufacturing exhibited buyer-seller relationships that were atypical in such an environment. "[W]hat goes on in the industry," he wrote, "cannot be called private enterprise in any conventional sense; it lies instead in the grey area between private and public enterprise."[27]

The neither-fish-nor-fowl aspect of the aircraft industry manifested itself in several ways. For one thing, impersonal market forces did not determine prices and profits. Those were usually negotiated between the government buyer and the industry seller, in which the former assumed much of the latter's traditional risk.[28] For another, the government paid for much of the industry's equipment and physical plant, normally a private-sector responsibility. Thus, during the Korean War, taxpayers financed more than 80 percent of the nearly $2.5 billion spent on new equipment.[29] In the mid-1950s, the government owned about 70 percent of the industrial floor space of 12 major aircraft manufacturers.[30] Additionally, the dividing line between the two had become so indistinct that, in come cases, the government dictated corporate management structure or even the selection of top-level company managers.

Mutual dependence between the government and the aircraft industry should have resulted in a degree of equality. Relying on air power to guarantee national security, the government had to ensure a healthy aircraft industry. The manufacturers, in turn, had no other customer of comparable significance. The government's chief leverage was that the aircraft manufacturers competed with each other, but the government dealt with each of them individually, not in the aggregate. Thus, although depending on the industry generally, the government did not necessarily need any single manufacturer. An industry executive described the government's advantage in a letter to Secretary of the Air Force Symington early in 1948: "The industry as a whole is essential to national defense. However, it must be admitted that no particular unit in the industry is essential. Hence, like a public utility, the industry as a whole must be permitted rates which will enable it to survive, but unlike a public utility, each unit does not need an arrangement which will necessarily mean survival."[31]

The government's position was strongest prior to the award of a contract. After that, the manufacturer was able to redress some of the previous imbalance in the relationship. Although it had the right to terminate a contract for lack of performance by the contractor, the government rarely took such action because doing so risked loss of the system that it wanted to acquire. The government's reluctance to terminate a contract intensified as the amount of money invested in the system's development and production increased.

Aside from this significant advantage that a company possessed once the contractual relationship had been initiated, the government held most of the trump cards when dealing with the industry as a whole, and the aircraft manufacturers had little choice but to accede to policies that they disliked. High, if not first on the list, was government's attempt to control industry profits. A series of "renegotiation" acts passed by Congress beginning in 1942 and continuing into the postwar period enabled the government to capture "excess profits" (excess as a percentage of costs) by modifying prices that had been agreed to at the outset of a contract.[32] Given the long-standing suspicions of many Americans that companies engaged in defense work were essentially "war profiteers," aircraft manufacturers and other industries sought to make the best of the unfavorable climate of opinion. If contracts were to be renegotiated, industry maintained, then efficient companies that contained costs should be able to share some of the savings with the government.[33]

Ownership of patents was another major point of friction. Normally, the company that had designed and developed a system expected to receive the production contract, even though the work had been paid for by the government. The government, however, maintained that in contracting for development of a system it was also purchasing reproduction rights and could subsequently award the manufacturing contract to whomever it chose.[34] In 1953, for example, Fairchild received a contract to produce the C–123 Provider, an air transport that had been developed by Chase Aircraft (see subsequent chapter section).[35] To protect their investments, aircraft manufacturers demanded clauses in development contracts that provided for payment of license fees and royalties should another company ultimately produce the system. Thus, although Convair accepted the Air Force's letter of intent and began work on the F–102 in September 1951, negotiations over the extent of fee and royalty payments delayed agreement on a final contract until March 1953. In this instance, Convair prevailed; the Air Force granted the company a liberal patent clause.[36]

Government pressure to "spread the business" through subcontracting also met resistance from some aircraft manufacturers. Subcontracting took two principal forms. In one, the prime contractor executed an agreement with another contractor to supply specified materials, products (e.g., a subsystem or component), or services necessary for the performance of the prime contract. In the other, sometimes called "cross-licensing," several companies might manufacture a product that had been developed by one of them. During World War II, subcontracting had been widespread, accounting for as much as 50 percent of airframe sales.[37] But after the war, it dropped off sharply. For a variety of reasons, the government sought to expand the practice. Some were strategic: to increase mobilization capacity by developing additional manufacturing sources or to make the industry less vulnerable to enemy attack by achieving a greater geographic dispersal. Other reasons had economic and social roots: to avoid financing construction of new industrial facilities, to assist small business, or to provide relief to areas of the country experiencing high unemployment.[38]

Industry opponents of subcontracting expressed several concerns. Some manufacturers maintained that the subcontractor's start-up expenses added to production costs.[39] Others believed that subcontracting complicated the production process. Edward H. Heinemann, Douglas' chief engineer, asserted that subcontracting "works a great hardship upon the aircraft plant manager and his operations since it seriously dilutes his supervision, inspection, and engineering talent and confronts him with many new problems of trucking, shipping, rejection, reworks, supplying material, guaranteeing schedules and so on."[40] Still other manufacturers disliked depending on the performance of other firms, some complete "newcomers" to the business. According to retired Admiral Ramsey, president of the Aircraft Industries Association during the Korean War, "it is clear that when we bring into the ranks of the companies normally engaged in the production of airplanes, engines, and aircraft accessories, new companies embarking on new and difficult ventures and lacking perforce the experience and know-how of the established industry, we are taking a calculated risk. . . ."[41] Whenever possible, the aircraft manufacturers preferred to subcontract with each other. They were particularly unhappy about the intrusion of the automobile companies into the production end of their business. Loss of sales does not account for all of this resentment. During World War II, when there was plenty of business to go around, Republic Aviation's president, J. H. Kindelberger, likened the auto industry's conversion to aircraft manufacturing to blacksmiths becoming watchmakers.[42]

The lukewarm attitude of some aircraft manufacturers notwithstanding, subcontracting experienced a resurgence during the Korean War and held steady at 30 to 40 percent of production in the years that followed.[43] In 1955, for example, *Fortune* magazine reported that United Aircraft dealt directly with as many as 7,000 subcontractors and suppliers and North American with 10,000. In all, the aircraft industry's network of such companies exceeded 50,000.[44] The extent of subcontracting by then was only partly due to government policy; the industry had come to accept it as an essential element in manufacturing the complex aerial weapons of the day.[45]

Next to its dependence on government purchases, the development and application of advanced technology most characterized the aircraft industry following World War II. This emphasis, in general, derived from the national security strategy that relied upon science and technology to trump the advantage in numbers that likely would be enjoyed by potential enemies, but also because the Air Force lacked a significant research and development capability of its own. Consequently, through the end of the Korean War, about 80 percent of the Air Force's appropriations for research and development went to industry, academic institutions, and the National Advisory Committee for Aeronautics.[46] Industry captured the lion's share of these funds.[47]

To take advantage of the relatively high level of military expenditures for research and development after World War II as compared with the prewar period, and to acquire the expertise necessary for developing advanced systems, the aircraft manufacturers maintained large engineering staffs. In 1952, the industry employed 20,000 of the nation's 90,000 professional research scientists and engineers.[48] Mundy Peale, president of Republic Aviation, told an audience at the Industrial College of the Armed Forces early in 1948 that "(e)ngineering is one field where a nucleus of personnel is not sufficient. When current problems are facing us, it is frequently necessary to have a larger staff of engineers on a given project than might be necessary once the project is fully developed."[49] Convair, for example, eventually used 2,600 engineers to develop and produce the supersonic B–58.[50] But not every aircraft manufacturer threw large numbers of engineers at development projects. During World War II, Lockheed's famous "Skunk Works" had designed the jet-powered P–80 fighter with 23 engineers in 143 days. After the war, the company followed the same strategy with other aircraft—a like number of engineers produced the high-flying U–2 reconnaissance plane in just 80 days.[51]

Advanced technology also played a key role in the new techniques applied by the aircraft industry to the manufacturing process, perhaps the most important of which was the introduction of automated, or "numerically controlled," machine tools. First developed by the Massachusetts Institute of Technology under an Air Force contract beginning in 1952, they operated according to coded instructions that had been calculated by a computer and imparted to a perforated or magnetic tape. One of the purposes for the devices was to achieve greater speed and consistency in the production of aircraft parts that required precise machining. In 1958, Republic was using three of the automated tools in manufacturing the Air Force's F–105 fighter-bomber at the company's plant in Farmingdale, New York.[52]

In addition to numerically controlled machine tools, aircraft manufacturing employed other new production equipment, techniques, and materials. Behemoth-size forging presses capable of exerting 50,000 tons of force could turn out single-piece aircraft components that previously had been made up of hundreds of parts. For example, 4 one-piece wing spars fabricated for the F–102 by one of these machines replaced almost 3,500 parts (including 3,200 rivets) that had been needed when traditional construction techniques were used.[53] Mechanical manufacturing methods, however, were not always appropriate. Pioneered by North American Aviation during World War II, a chemical milling process could achieve fine tolerances for parts not suitable for chip machining.[54] Whatever the means of fabrication, components made from aluminum—the standard aircraft structural material—grew hotter and lost strength as speeds reached twice the speed of sound and beyond. To solve the problem, manufacturers turned to titanium, a more heat-resistant and stronger metal, even though it cost much more than aluminum to extract from nature and to machine during production.[55]

This giant hydraulic forging press—five stories high, weighing 6,000 tons, and capable of exerting 50,000 tons of force—was built by Mesta and housed in a 12-acre facility constructed and operated for the Air Force by Alcoa at its plant in Cleveland, Ohio.

Although numerically controlled machine tools and heavy presses were capable of manufacturing components in large quantities, the postwar aircraft industry was not the mass production enterprise of World War II. From 1942 through 1945, U.S. industry manufactured an average of nearly 70,000 military aircraft per year while employing mass production methods such as stable designs and assembly lines. But in 1953—the peak post–World War II production year—it built fewer than 9,000 planes.[56] Moreover, many believed that a defense strategy based on maintaining technological superiority could not be limited to relying on a few standard aircraft types that had been subject to design freezes, as in World War II. Indeed, postwar aircraft frequently required modification to accommodate technological advances even as development and production proceeded concurrently. In light of this characteristic of postwar aircraft manufacturing, some observers describe the industry as having returned to prewar "handcraft" methods.[57] The term, however, is somewhat misleading because it masks the machine tool's critical role in both fabrication and assembly. "Custom built," the expression used by aircraft designer Edward Heinemann to characterize industry production, may be more descriptive.[58]

After World War II, no weapon system owed more to the application of science and technology than the guided missile. The aircraft companies had been involved in the field from its start during the war, and most of the major firms obtained postwar missile research and development contracts. But by the late 1940s, missile programs had been cut back along with reductions in defense spending. On the eve of the Korean War, for example, only three Air Force missiles were in full-scale development—North American's supersonic, intercontinental Navaho cruise missile; Bell Aircraft's bomber-launched, air-to-surface Rascal; and Hughes Aircraft's fighter-launched, air-to-air Falcon (see chap. 5).

Increased funding after 1950, technological advances in such fields as electronics and warhead production, and the sense of urgency provided by the Cold War competition with the Soviet Union accelerated missile development. The aircraft manufacturers believed that their industry was best suited to fulfill the new requirement. As they saw it, the missile had the same basic subsystems as the airplane—airframe, guidance, and power plant; the aircraft industry employed a sizeable chunk of the nation's professional research scientists and engineers; and the aircraft companies had more experience dealing with the government than other industrial sectors.[59] Despite these advantages, the aircraft manufacturers faced stiff competition from other industries that also emphasized advanced technologies, particularly electronics.[60] In 1958, for example, non-aircraft producers were the prime contractors for 16 of 40 of the armed services' missile projects.[61]

For the most part, however, the aircraft manufacturing industry adapted well to the changed requirement. In 1956, missiles made up only 6 percent of the industry's sales, but by 1961 the figure stood at 44 percent. Most significantly, the share of total missile sales claimed by the airframe companies jumped from less than one-fourth in 1956 to three-fourths in 1961.[62] In 1961, in a reflection of the industry's changing character, the Aircraft Industries Association changed its name to the Aerospace Industries Association.

THE AIR FORCE AND THE INDUSTRY'S POSTWAR CRISIS

In September 1945, the month World War II officially ended, AAF leaders stated to a gathering of aircraft company executives at the Pentagon (described in chapter 5) that the postwar Air Force would be "absolutely dependent" on their industry. By mid-1947, however, aircraft manufacturing seemed to be in such poor condition that Lt. Gen. Ira Eaker, the AAF's deputy commander, warned an audience at the National War College (perhaps for effect) of the likelihood that the industry would "disappear."[63] In July, President Truman appointed a special Air Policy Commission headed by Thomas K. Finletter, a future secretary of the Air Force, to look into the state of the nation's aviation resources. Congress soon followed with an investigating group of its own, the Air Policy Board. Early in 1948, the reports of both bodies highlighted the aircraft industry's depressed condition and urged substantial increases in aircraft procurement. Following heightened international tension in the late winter and early spring, Truman asked Congress for a supplement to the FY 1949 defense budget that included substantial sums to build up air power. In May 1948, Congress passed and the president signed legislation providing almost $3.2 billion for this purpose, nearly three times what the administration had originally proposed in January (see chap. 2). As a result, the nation's air power was strengthened and aircraft manufacturing's decline halted. The Air Force played an important part in saving the aircraft industry. But, had it not been for the aggressive leadership of then Assistant Secretary of War for Air Symington, who responded to appeals from industry executives, the soon-to-be-independent Air Force might have remained passive during the crisis.

W. Stuart Symington
Courtesy, Special Collections, U.S. Air Force Academy Library.

W. Stuart Symington (1901–1988)

As the Army Air Forces achieved independence and the Air Force became the nation's first line of defense after World War II, W. Stuart Symington was the service's most vigorous civilian proponent. He tirelessly and forcefully presented Air Force programs to the secretary of defense, the Bureau of the Budget, the president, Congress, and the public, initially as assistant secretary of war for air (1946–1947), and then as the first secretary of the Air Force (1947–1950).

Born in Amherst, Massachusetts, in 1901, Symington graduated from high school in Baltimore, Maryland, in 1917; enlisted in the Army as a private; and was commissioned in 1918, one of the youngest second lieutenants in the service. After World War I, he attended Yale but did not graduate, choosing instead to enter business. During the interwar period, Symington worked in a variety of enterprises, rising to the presidency of both radio and steel manufacturing companies. In 1938, he became president and chairman of the board of Emerson Electric Manufacturing Company of St. Louis, Missouri, which operated the world's largest airplane armament plant during World War II, producing power-driven gun turrets for U.S. bombers.

Called to government service in July 1945, Symington served as chairman of the Surplus Property Board and then as Surplus Property Administrator.

In February 1946, President Truman nominated his fellow Missourian to be assistant secretary of war for air. In September 1947, he became secretary of the Air Force and served in that post until April 1950.

As the civilian head of the Army Air Forces and then the Air Force, Symington deferred to the uniformed military regarding the determination of both qualitative and quantitative requirements for weapon systems. Years later, in retirement, he recalled his role: "[A]fter Spaatz [General Carl Spaatz] and his staff reached decision on military matters, I would do my best to sell those decisions to the Administration and on the Hill. Some secretaries after me were prone to make military decisions. Not me; that was for the trained experts." This view did not mean that Symington was a passive administrator. More than many of the airmen, he recognized air power's dependence on a healthy aircraft manufacturing industry, and sought to distribute the service's procurement contracts so as to help keep the industry alive during the drawdown that followed World War II.

Symington's outspoken advocacy of his service, particularly his unswerving support for an Air Force of 70 combat groups, led to conflict with Truman administration officials who sought to limit military spending. Indeed, so strained were Symington's relations with Secretary of Defense James Forrestal that the latter more than once thought about requesting his Air Force secretary to resign. Frustrated by cuts to the Air Force budget, Symington finally left his post in April 1950.

Despite his resignation, Symington remained friends with President Truman, who named him to two positions in the administration, first as chairman of the National Security Resources Board and then as administrator of the Reconstruction Finance Corporation. In 1952, Symington was elected to the Senate from Missouri, serving four terms until retiring in 1976.[I]

Scholars have interpreted the industry's rescue in different ways. Historian Donald J. Mrozek argues that the president, along with key White House advisors such as Clark Clifford, took the initiative. After World War II, these officials had become convinced that a strong aircraft manufacturing industry closely tied to the military was needed to integrate fully the nation's security resources and thereby achieve a better defense at a lower cost. According to Mrozek, neither the military services nor the aircraft manufacturers had much to do with advancing this objective. The services, he contends, were preoccupied with battles over unification, and the aircraft manufacturers wanted to escape the restrictive controls that they had experienced during the war and pinned their hopes on aviation expansion in the civilian economy. Only when the commercial market failed to materialize did they begin to seek government aid.[64]

In contrast, Frank Kofsky, another historian, contends that the aircraft industry was the prime mover of its own salvation; it sought close ties with the government much earlier and more aggressively than Mrozek has suggested. Well before the end of the war, Kofsky points out, some aircraft manufacturing executives had come to believe that military contracts would be necessary to keep plants in operation when peace returned. Late in 1946, he relates, the industry began to lobby government officials intensively in an extraordinarily effective campaign spearheaded by retired Maj. Gen. Oliver Echols, the new president of the Aircraft Industries Association. In mid-1947, Echols persuaded the Air Coordinating Committee, the federal government's interagency aviation policy body, to recommend that the president appoint a group to determine "what economically feasible steps and procedures are required to maintain an aircraft industry of the size necessary for preservation of national security and to meet the needs of our air transportation system." After the resulting Finletter Commission issued its pro-air power and pro-industry report in January 1948, asserts Kofsky, the president and other executive branch leaders manufactured a war scare that enabled the administration to achieve key national security policy objectives. These included reinstitution of selective service, funding for the European Recovery Program (Marshall Plan), and a supplemental appropriation for aircraft procurement. According to Kofsky, the government bailed out the aircraft manufacturers because the "ruling class" thought the nation's economic system might break down should such an important industry collapse.[65]

Although company executives had launched the lobbying campaign and pushed it forward, Kofsky demonstrates that Air Force leaders, committed to air power's expansion, were sympathetic to the industry's plight and willing to front for the manufacturers under the banner of national security. In February 1947, Assistant Secretary of War for Air Symington, after receiving a letter from the president of Fairchild Engine and Airplane Corporation that outlined the company's economic difficulties, wrote to General Spaatz, the AAF's commander: "It now appears as if the Air Forces must face the problem of what is going to happen to the aviation industry."[66]

Initially, the Air Force assisted the aircraft manufacturers by supporting the proposal for a national air policy board that the latter had presented to the Air Coordinating Committee in the spring of 1947.[67] Then, when the Finletter Commission was appointed, Symington urged its chairman to back Air Force expansion to 70 combat groups and to promote subsidies for the airlines as a way to supplement military capability. To equip and maintain both the Air Force and the commercial airlines, he wrote Finletter, would require "an adequate aviation manufacturing industry."[68]

The aircraft manufacturers, of course, welcomed Symington's support. Strong recommendations by the Finletter Commission might result in stepped up government purchases that would put the aircraft industry on a stable footing. But even if the commission's recommendations bore fruit, relief would not come immediately.

Despite rhetoric from Air Force officials about the critical importance of a healthy aircraft manufacturing industry, the service's procurement program for FY 1948 gave scant consideration to this objective. Late in August 1947, the AAF's (soon the Air Force's) newly established Aircraft and Weapons Board, an all-military body comprised of the AAF's deputy commander, the assistant chiefs of staff, and the commanders of the principal operating commands, met to discuss the FY 1948 program. The board recommended to General Spaatz and Secretary Symington that 90 percent of the $525 million available for aircraft purchases go to three companies—Boeing, North American, and Republic. Eight other firms would share the remainder.[69] Some companies, Douglas for example, would not receive any contracts.

Review of the transcripts of the Aircraft and Weapons Board's sessions of August 1947 reveals that although its members were aware of the importance of maintaining a strong aircraft industry for national security and that companies failing to receive contracts might be adversely affected, the board based its recommendations solely on technical considerations. The following excerpt from the board's discussion of whether the Air Force should purchase a four-engine, heavy transport built by Boeing, the C–97 Stratofreighter (essentially a modified B–29), or the C–74 Globemaster, a comparable aircraft, manufactured by Douglas, demonstrates this operational orientation:

> *General Vandenberg [AAF deputy commander]:* What will that do to Douglas if we buy the C–97s?
>
> *General Powers [the assistant chief of AirStaff, materiel]:* Douglas told me they would be out of business completely in the two plants [at Long Beach and at Santa Monica, California] when they finished their present DC–6 line. They have nothing in sight.
>
> *General Vandenberg:* Who builds the 97?
>
> *Several Members of the Board:* Boeing.
>
> *General Vandenberg:* What will happen to them if we don't?
>
> *General Powers:* Nothing. They have a B–50 [production] line and about 40 C–97s for commercial [sale]. . . .
>
> *General Vandenberg:* What is the consensus of the Board whether or not we really take that into consideration?
>
> *General LeMay [the deputy chief of Air Staff for research and development]:* I don't think we can.
>
> *General Powers:* There is only one point there, Mr. Chairman [referring to Vandenberg] and that is that Douglas has been our principal producer of transport airplanes over a period of years. . . . They are one of the major aircraft companies, and consistent with other considerations if we can throw them some business, it will make the aircraft industry that much more healthy. Boeing will survive on the business that they have for the next two or three years. Now whether we can consider it to that extent or not, is a question that will have to be decided.
>
> *General Vandenberg:* I don't think we can. General Williams [commanding general, Tactical Air Command], you say that the C–74 does not meet the requirements of your people . . .
>
> *General Williams:* Not for combat loading. I've seen it and it wouldn't be satisfactory at all, in my opinion.

> *General Vandenberg:* Are there any other comments before we vote?
>
> *General Rawlings [the AAF comptroller]:* General [addressing Vandenberg], this is one case where the commercial version is helping to carry part of the cost, because Boeing does have some commercial orders [for the C–97]. . . .
>
> *General Williams:* Here is another factor, too: If the commercial lines [airlines] are going to go to the C–97s as indicated, that is another reason why we should go to the C–97s. They can be commandeered in time of emergency, and their crews and pilots would be capable of being taken on.[70]

The board then voted unanimously to recommend purchase of 27 Boeing C–97s.[71]

The Aircraft and Weapons Board's selection of Boeing's C–97 instead of Douglas' C–74—giving preference to operational performance over other considerations—was the usual practice in the Army Air Forces. Early in 1948, General Joseph McNarney, head of the Air Materiel Command, informed General Spaatz that the service's procurement policy had several objectives: acquiring the most capable system through a design competition with the winner normally also receiving the production contract; promoting geographic dispersal of the aircraft industry; balancing the distribution of business among the aircraft manufacturers; maintaining multiple sources for each type of aircraft; eliminating factory conversions required by frequent changes from one aircraft type to another in the same manufacturing facility; and encouraging new sources of supply. McNarney pointed out, however, that contract "awards have been made primarily as a result of technical excellence." Only "secondary consideration," he wrote, "has been given to the attainment of other objectives which have as important a bearing on the strength of the Air Force and the security of the country as does the technical excellence of the articles themselves." One of the results of the focus on performance, McNarney concluded, was that three aircraft companies received most of the Air Force's business.[72]

Douglas Aircraft, as noted earlier, was not among the 11 manufacturers slated to receive FY 1948 procurement funds.[73] Within days of the conclusion of the Aircraft and Weapons Board meeting, Donald Douglas, almost certainly aware that his company was not included in the Air Force's FY 1948 procurement program, contacted top Pentagon officials for help. He met with both Secretary of Defense Forrestal and Symington in the last week of August 1947. According to Kofsky, Douglas urged that production contracts not be restricted to the company that had developed a system, but be shared by other firms under licensing arrangements with the developer. In this way the procurement dollar would be more evenly distributed, something Douglas knew Forrestal favored. In arguing for a change in procurement policy, Douglas may have been genuinely concerned about the entire aircraft industry. His immediate interest, however, was obtaining help for his own company, and he asked that the Air Force buy some Douglas DC–6 transports.[74]

Donald W. Douglas, Sr.
Courtesy, History Office, Space and Missile Systems Center, Air Force Space Command.

Donald W. Douglas, Sr. (1892–1981)

On 22 November 1943, Donald Douglas' portrait appeared on the cover of *Time*, the weekly newsmagazine. He was, like William Boeing, the Loughead (Lockheed) brothers, Glenn L. Martin, and others, among the pioneers of the U.S. aviation industry. These "barons of the sky," usually with few assets of their own, founded small, even tiny, aircraft design and manufacturing companies early in the twentieth century that became industrial colossi during World War II, and then cornerstones of the postwar "military-industrial" complex.

Born in Brooklyn, New York, in 1892, Douglas witnessed the trials of the Wright *Flyer* at Fort Myer, Virginia, in July 1909, while on a trip with his mother. Although he never became a pilot, Douglas was such a serious student of aeronautical engineering that he resigned from the Naval Academy in 1912 to pursue this interest at the Massachusetts Institute of Technology, from which he graduated in 1914. The next year, he became chief engineer of Glenn Martin's aircraft company, headquartered in Los Angeles, and in 1916–1917, served as the chief civilian aeronautical engineer in the Aviation Section of the Army Signal Corps.

After World War I, Douglas returned to work for the Martin Company, this time as chief engineer of its plant in Cleveland, Ohio. In 1920, he left Martin, headed west, and cofounded in Los Angeles (with the help of capital provided by his partner, an aviation sportsman) what became the Douglas Aircraft Company. During the interwar years, the company designed and built aircraft for both the commercial and military markets. In the 1930s, it introduced the DC series of transport aircraft, including the legendary DC–3 (the C–47 "Gooney Bird" of World War II).

World War II proved hugely profitable for Douglas Aircraft. In 1940–1945, it built 30,980 aircraft (10,368 C–47s) for the Army and Navy, 16 percent of the U.S. aviation industry's output measured by weight. In these same years, the company earned a profit of $60.8 million on sales of $3.5 billion. Although only 1.7 percent of sales, this figure amounted to five times its cumulative profit from 1922 through 1939. In addition to military transports such as the C–47 and C–54 Skymaster (DC–4), Douglas Aircraft designed and built the SBD Dauntless dive bomber that sank four Japanese aircraft carriers on one day during the battle of Midway in June 1942, and the A–20 Havoc and A–26 Invader bombers. Along with its own aircraft, Douglas also manufactured the Boeing B–17 Flying Fortress and the Consolidated B–24 Liberator bombers. At its wartime peak in 1944, the company employed more than 160,000 people at six plants around the country.

Thanks in part to a contingency fund set aside from its wartime income, Douglas Aircraft was able to survive the aviation industry's immediate postwar decline. In the commercial transport arena during the 1940s and 1950s, the company competed, first with Lockheed and then with Boeing, but did not fare well against the latter, which developed a jet transport, the 707, well before Douglas brought out its own jet-powered transport, the DC–8. Military business sustained the company. "Through the years, we have been mainly supported by our government," Donald Douglas remarked. The company's postwar contracts included several transports for the Air Force, and the AD–1 Skyraider as well as the A3D Skywarrior and A4D Skyhawk for the Navy. Like several aircraft manufacturers, Douglas also expanded into space and missile systems, notably the Nike Ajax air defense missile for the Army and the Thor intermediate range ballistic missile for the Air Force.

In 1957, although remaining as chairman of the board, Donald Douglas, Sr., turned over the presidency of the company to his son, Donald W. Douglas, Jr. In 1967, unable to attract sufficient operating capital and facing bankruptcy, Douglas Aircraft merged with the McDonnell Aircraft Corporation of St. Louis, Missouri, to form the McDonnell Douglas Corporation. Ironically, in 1997, McDonnell Douglas merged with Boeing, once Douglas Aircraft's fiercest competitor.[II]

Douglas' appeal soon produced results. During the first week in September, General Vandenberg held an ad hoc meeting of the Aircraft and Weapons Board "to see if any adjustments [to the FY 1948 procurement program] could be made to assist the industry."[75] The board found that indeed some changes could be made and recommended that the Air Force buy 20 DC–6s. Following the meeting, Vandenberg wrote Symington that "[i]t is my understanding that Mr. Douglas advised you that such a purchase would tide him over."[76]

Donald Douglas was not the only aircraft manufacturer to appeal directly to National Military Establishment leaders. In mid-September 1947, Lockheed President Robert Gross also contacted Symington.[77] By this time, Gross, like Douglas, probably knew what the Aircraft and Weapons Board had recommended in August and that Lockheed was in line to receive only a small, $3.5 million production contract—20 of the training version of the company's P–80 jet fighter.[78] At Symington's suggestion, Gross wrote General Spaatz requesting that the Air Force buy 10 to 12 of the company's Constellation passenger transports reconfigured to carry cargo at a total cost of $10–$12 million.[79]

Gross was now the second squeaky wheel needing grease. Early in October, General Spaatz directed the Aircraft and Weapons Board to procure "a number of commercial-type transports" in the FY 1948 program. The purpose would be to maintain "the existence of certain elements of the aircraft industry."[80] The funds would come from reducing the number of B–50 bombers, C–97 transports, and F–12s (photographic reconnaissance planes built by Republic) previously scheduled for purchase.[81] Spaatz did not specify to the board either the type or the number of commercial transports.

The Aircraft and Weapons Board met again at the end of January 1948 to consider both the FY 1948 and the FY 1949 programs. Despite Vandenberg's earlier indication to Symington that 20 Douglas DC–6s would be procured, the revised FY 1948 plan provided only for 10. The reduction probably reflected a decision to buy 10 reconfigured Lockheed Constellations, apparently in response to Gross' letter to Spaatz.[82]

The problem faced by the board with respect to the Lockheed Constellation and the Douglas DC–6, both medium transports, was that from an operational perspective the Air Force did not need either airplane. Maj. Gen. Robert T. Harper, commander of the Air Transport Command, explained during the meeting that the DC–6s would be useful as replacements for the older C–54s, but they were not "absolutely essential."[83] Rather than a medium transport, what the Air Force most required was a heavy transport capable of carrying 50,000 pounds in support of the ground forces.

At its meeting in August 1947, the Aircraft and Weapons Board had decided to buy Boeing C–97 Skymasters rather than Douglas C–74 Globemasters to fulfill the ground support role, even though neither aircraft was ideal for that purpose. By the January 1948 meeting, however, Douglas had redesigned the C–74 to better satisfy the military's operational requirements. Thus, the board was able to apply the FY 1948 funds that it had tentatively allocated for the purchase of 10 Douglas DC–6s to buy 4 prototypes of the modified C–74s instead. It also recommended that 8 C–74s be bought in FY 1949. As General McNarney put it: "If we are going to help him [Douglas] out with C–74s, why worry about DC–6s." With respect to the Boeing C–97s, the board decided to go ahead and buy them as an interim measure until the modified C–74s could be fully tested and approved for quantity production.[84]

The initial meeting of the Aircraft and Weapons Board in August 1947 clearly showed how reluctant senior military officers were to base procurement recommendations on anything other than operational performance. Although one of the objectives of the service's procurement policy was to balance distribution of contracts, the board did not attempt to "spread the business"; it gave exclusive weight to technical factors. Only after Symington—who had been prodded by industry executives—pressured the service's uniformed leaders did the board recommend assisting companies such as Douglas and Lockheed that appeared to be in financial trouble. In other words, had procurement decisions been left to the military officers alone, some companies might have gone under.

The Air Force did not hide the fact that it spent FY 1948 procurement funds to aid the aircraft industry. In his public report to the secretary of defense for that year, Symington noted the difficulties the industry faced in the fall of 1947 and that "[e]very effort was made during the winter of 1947–1948 . . . to encourage distribution of available business to the most reliable sources."[85] But the approximately $25 million the Air Force reprogrammed to assist Douglas and Lockheed, while certainly important to those companies, was less than 5 percent of the $525 million available for aircraft procurement in its FY 1948 budget.[86] And even the larger amount was itself a fraction of what most believed the industry needed. In the fall of 1945, the interdepartmental Air Coordinating Committee had estimated that the government would have to buy at least 3,000 aircraft, or about 30 million pounds of airframe weight, annually to assure an industry healthy enough to be able to expand rapidly.[87] The $525 million in the Air Force's FY 1948 budget would buy only about 650 planes.[88]

Additional assistance was soon forthcoming. The almost $3.2 billion appropriated by Congress for aviation procurement in the spring of 1948 for FY 1949, including an additional $822 million for the Air Force not sought by the president, was enough to resurrect the failing aircraft industry. As Arthur Barrows, under secretary of the Air Force, asserted, the "main purpose" of supplemental funds was "to get the industry off its knees and on to its feet."[89] In all, the Air Force received about two-thirds of the total appropriation (the Navy the remainder) and planned to spend just over $1.5 billion to purchase new aircraft. The Air Force announced that these funds would make it possible to buy 2,727 planes—243 bombers, 1,575 fighters, and 909 reconnaissance, transport, training, rescue, and liaison aircraft.[90]

In addition to quadrupling the number of planes that the Air Force could buy over the quantity purchased in FY 1948, the funds provided by Congress would also enable the service to distribute contracts more widely. In contrast to the original FY 1948 program, under which three firms received nearly 90 percent of the allocation for new aircraft purchases, the Air Force planned to "spread the business" in FY 1949. Although funds would still be concentrated among a few manufacturers, the FY 1949 program called for the share held by the top three to decline from 90 percent to less than two-thirds of the total. Initially, the three firms slated to receive most of the appropriation were Boeing, North American, and Northrop. By mid-1949, however, Convair had replaced Northrop because of the Air Force's decision to cancel procurement of the reconnaissance version of Northrop's B–49 "flying wing" in favor of increased B–36 procurement. Counting those outstanding from prior years, the Air Force had procurement contracts with 16 aircraft manufacturers.[91]

The hopes for dramatically increased aircraft production, so evident in May 1948, fell over the next year as the economy-minded Truman administration limited Air Force expansion. First, the president refused to authorize the Air Force to spend the additional $822 million Congress had appropriated. Next, he put ceilings on the military budgets for FY 1950 and FY 1951. Instead of steady progress toward 70 combat groups, the Air Force would only be able to deploy 48. The reductions forced the Air Force to revise its procurement schedule beginning early in 1949 and to cancel or reduce some contracts for planes that it had ordered the previous spring.[92]

Aircraft production did not climb as sharply as many had initially expected in mid-1948, but by the end of the decade the industry was undeniably in a stronger position than it had been at any point since the war. In calendar years 1946 and 1947, the aircraft companies had built approximately 1,400 and 2,000 military aircraft, respectively. Production increased to just over 2,500 aircraft in 1948, and to nearly 2,700 in 1950.[93] Since military aircraft generally, but bombers especially, grew progressively heavier after World War II, pounds of airframe weight manufactured may be a better indication of the industry's general health than numbers of planes. In each of the years 1946 and 1947, the aircraft companies turned out fewer than 13 million pounds of military airframe weight; the annual average of the three years 1948 through 1950 was 30 million pounds.[94]

Whether some companies would have closed their doors had they not received orders for new aircraft in mid-1948 cannot be determined. Until that time, almost three years after the end of the war, none had been forced out of business.[95] In any case, the aircraft manufacturers had convinced policymakers that their situation was desperate, and government leaped, at least partially, into the breach. For historian Kofsky, the nation's physical security had nothing to do with the aid package; the motive was "ruling class" desire to ensure the survival of an industry whose failure might lead to the collapse of the nation's socio-economic system. There is, however, another explanation—a rationale provided by the Air Force in 1948 but completely ignored by Kofsky.

In his report for FY 1948 to the secretary of defense, Symington explained that Air Force procurement funds had been spread more widely to prevent "a dangerous curtailment of the *base* for future aircraft expansion."[96] The Air Force desired a broad industrial base for three reasons. First, it hoped to expand from 48 to 70 combat groups. Second, unlike the Army and Navy, the Air Force had relatively little organic research and development and no manufacturing capability; it depended heavily on outside sources, particularly the aircraft industry to perform these functions. Third, a well-developed aircraft industry would be needed should the country have to mobilize for war. In time, the existence of arsenals of thousands of nuclear warheads carried by long-range aircraft or intercontinental ballistic missiles would undermine arguments for a significant mobilization capability. But in 1948 that day was far off, and defense officials were most influenced by the war just concluded. They expected the next war to be similar to the last—a long, total conflict between industrial nations using advanced, mass-produced weapons. Indeed, American leaders counted on superior technology to prevail in wars that lay ahead. But for the foreseeable future, they recognized that the number, power, reach, and speed of those weapons would not be sufficient to eliminate the need to mobilize rapidly. None had forgotten the many months it had taken the United States to establish a war economy during World War II.

THE AIR FORCE, BOEING, AND B–47 PRODUCTION

After averaging only approximately 2,500 planes annually during calendar years 1948 through 1950, military aircraft production surged ahead in the next several years. As a result of the rearmament that followed the start of the Korean War and heightened fears of global conflict with the Soviet Union, the number of military planes manufactured rose to just over 5,000 in calendar year 1951 and to nearly 9,000 in calendar year 1953.[97] The Boeing Company's swept-wing, B–47 Stratojet strategic bomber was a major part of the expanded production. Only North American's F–86 fighter, dueling Soviet-built MiG–15s in the sky over Korea, held a higher manufacturing priority among Air Force aircraft.[98] By July 1953, 563 B–47s had been delivered; in January 1957, when production ended, 2,041 B–47s had entered the inventory.[99] From the early 1950s through the early 1960s, the B–47 was the most important nuclear weapons delivery system in the U.S. strategic deterrent force. Judged, however, from its early production record, few would have guessed the bomber would be so successful.

In the fall of 1950, the Air Force accelerated the B–47 program, proceeding to quantity production before development was finished. The speedup encountered obstacles. Delivery schedules slipped when major subsystems were not ready for incorporation into the basic airframe. Although the planes were not combat ready, the Air Force accepted them and began a postproduction modification program to prepare the aircraft for assignment to operational units. The rough start to B–47 production strained relations between the Air Force and Boeing. But, by mid-1953, most problems had been overcome, and the operation was running smoothly. Nevertheless, the record revealed the hazards associated with initiating quantity production of a weapon system comprised of advanced technologies before development and testing had gone far enough to achieve system integration and demonstrate reliable performance.[100]

Until mid-1950, the B–47 program had generally conformed to the Air Force's traditional, sequential acquisition strategy: design approval was followed by construction of experimental prototypes, testing and continued development, manufacture of additional prototypes for further testing and modification, and finally quantity production.[101] In February 1945, Boeing had received a letter contract to continue design work on its proposal for a high-speed jet bomber. In less than a year, the Army Air Forces approved the Boeing design (altered from its initial straight-wing, four-jet configuration to feature swept-back wings and six jet engines mounted in pods under the wings) and authorized the company to build and fly two experimental prototypes, the XB–47. Two years of development took place before the first XB–47, constructed at Boeing's facilities in Seattle, Washington, made its maiden flight on 17 December 1947 (coincidentally, the forty-fourth anniversary of the Wright brothers' first powered flight at Kitty Hawk, North Carolina). For the balance of 1948, Boeing and Air Force pilots tested the two XB–47s extensively.[102]

Boeing XB-47 at its roll out.
Courtesy, National Museum of the U.S. Air Force.

The B–47s top speed—over 600 mph—was remarkable for a bomber at that time and made Air Force leaders eager to add the aircraft to the service's inventory. Production planning began in December 1947, soon after the aircraft's first flight. Even so, the Air Force did not give Boeing a production contract until November 1948, well into the testing phase. The order called for 13 B–47As and, in a slight departure from the sequential pattern of acquisition, 41 B–47Bs.[103] The Air Force planned that the B–47As would be used only for testing and training; they were to be essentially "bare bones" versions, built without several of the subsystems, such as bombing and navigation and fire control, that would make the B–47B a combat system.[104] According to the delivery schedule, the first B–47A was due in April 1950 and the first B–47B in December of that year.[105]

The Air Force, concerned that Boeing's Seattle facilities were vulnerable to Soviet air attack, insisted that the B–47 be built at the company's government-leased plant in Wichita, Kansas, where it had manufactured B–29s during World War II.[106] In addition to strategic location, the Air Force had other reasons for preferring Wichita to Seattle: (1) opening production lines at Wichita would increase mobilization capacity, (2) extending the runway at Wichita to accommodate the B–47 would be less expensive than lengthening the Seattle runway, and (3) manufacturing the aircraft at Wichita would probably cost less.[107] It would take time to prepare the Wichita facility. When production ended there after World War II, Boeing kept only a relatively small work force to carry out modifications on the B–29 and to develop air-refueling equipment and techniques. Peak employment during the war had been 29,000. Just before B–47 production was initiated in 1948, the plant employed 1,500 workers.[108]

Strongly opposed to manufacturing the B–47 at Wichita, Boeing sent a delegation of its executives to Air Materiel Command headquarters at Wright-Patterson Air Force Base in Ohio to protest the decision. They made no headway with Air Force acquisition officials. Maj. Gen. K. B. Wolfe, then the Air Materiel Command's director of procurement and industrial planning, was reported to have reacted angrily to the Boeing plea, slapping the table and saying: "That's the way it's going to be and I don't want to hear any more about it."[109]

Boeing's president, William Allen, was not satisfied and appealed to Secretary of the Air Force Symington. In an exchange of letters and a face-to-face meeting in the spring of 1949, Allen presented the company's case. He argued that any national security advantage gained by transferring B–47 production to a different geographic location would be offset by the damage done to Boeing through the loss of skilled people who would be unwilling to move to Wichita. Furthermore, he maintained, separating design and development from production would detract from the efficiency of the operation:

> In order to accomplish the best results, it is necessary that the designer work closely with the builder and vice versa. Otherwise, the designer becomes too theoretical and impractical, and the builder, on the other hand, becomes completely unsympathetic to design problems and the necessity for constant improvement in the art. The best results are always achieved when there is a close liaison between engineering and manufacturing.[110]

William M. Allen, president, Boeing Company, 1945–1968, and chairman of the board, 1968–1972, with B–47 Stratojet.
Copyright © Boeing

Finally, Allen also raised the likelihood of unfavorable publicity. Since the Air Force had not been able to offer enough additional business for Boeing's Seattle operation to replace the jobs that would be lost to Wichita, Allen indicated that the company would be forced to lay off as many as 15,000 employees within a year. "Such an event," he wrote, "cannot take place without substantial repercussions. It will become a major public issue."[111] The Boeing chief executive was not overstating the company's importance to Seattle. In July 1949, Boeing employed 25,700 people and was the largest single industry in a city with a population of about 475,000.[112]

The prospect of large layoffs and a fear that the company might depart the local area completely, an anxiety Boeing executives did not go out of their way to dispel, did indeed arouse public concern. In the summer of 1949, the Seattle Chamber of Commerce established a "Keep Boeing in Seattle Committee" and lobbied Air Force officials in the Pentagon; Washington's governor appealed to the governors of neighboring states to assist him in supporting the company; and the Air Force received protest letters from the president of the International Association of Machinists and from one of Washington's representatives in Congress.[113] During a visit to Seattle in September, Symington was even confronted by groups of angry citizens.[114] But it was all to no avail. The Air Force stood firm and Boeing continued its preparations to manufacture the B–47 in Kansas.

On 25 June 1950, the first B–47A to be built at Wichita made its maiden flight.[115] That same day, the North Koreans attacked across the 38th parallel. Following the invasion of South Korea, the United States began to rearm, a buildup that increased in size and grew more urgent after Communist China entered the Korean War in November. Mirroring the overall rearmament effort, the pace of the B–47 program accelerated sharply, and its scope expanded dramatically.

In the last half of 1950, force levels approved for the Air Force increased steadily—from 48 wings in June, to 58 in July, and to 78 in September.[116] In December, soon after Chinese forces appeared in Korea, President Truman declared a national emergency and authorized an expansion to 95 wings to be completed by mid-1952. The new force structure was to include 20 medium bombardment wings and 4 medium strategic reconnaissance wings.[117]

To equip these wings with the most modern aircraft available, the Air Force decided to proceed immediately to quantity production of the B–47B and the strategic reconnaissance variant, the RB–47. The plans were ambitious. According to the schedule approved by the Munitions Board on 1 April 1951, the Air Force would procure 584 B–47Bs and RB–47s in FY 1951 and 286 in FY 1952. Counting the 10 B–47As and 87 B–47Bs already ordered, this meant a total of 967 aircraft to be delivered before July 1952.[118] The Air Force was also quite optimistic about how soon the B–47 wings would be combat ready. In December 1950, the Air Staff estimated that the first B–47 wing could be operational as early as January 1952.[119]

The generally upbeat tone muted some discordant notes. By December 1950, only one B–47A had been delivered, and the B–47B had yet to make its first flight.[120] Moreover, in contrast to the Air Staff, Boeing was much less sanguine about how soon the B–47 would be combat ready. In September 1950, Under Secretary of the Air Force John McCone asked the company when it thought that the first B–47 wing would be ready to deploy overseas. The answer—no earlier than mid-1953.[121]

Neither the Air Force nor other defense policymakers believed that a 95-wing force would be adequate should a sustained, global conflict requiring full mobilization occur. In his State of the Union message in January 1951, President Truman declared that "we are preparing the capacity to produce 50,000 modern military planes per year."[122] To broaden the industrial base sufficiently to produce this many aircraft, in mid-December 1950 Secretary of Defense George Marshall directed the armed forces to distribute contracts more widely, to employ additional contractors instead of using extra shifts or overtime if schedules permitted, and to make use of available plant space rather than expand facilities.[123]

B–47 production would reflect these procurement policies. Boeing would be the principal manufacturer, but two other aircraft companies would also produce the aircraft. Early in December 1950, Under Secretary McCone visited the company's Seattle headquarters. He told Boeing's President Allen that the Air Force was opposed to increasing production at Wichita beyond 30 aircraft per month and that "some other manufacturer should do the job."[124] Almost immediately, the Air Force issued letter contracts to Douglas and Lockheed to build B–47s at government-owned plants in Tulsa, Oklahoma, and in Marietta, Georgia, respectively.[125]

Using several production contractors presented many difficulties. One involved the compensation to be awarded to Boeing as the B–47's designer and developer. Neither Douglas nor Lockheed could manufacture the aircraft without technical assistance from Boeing, especially since the B–47 was still under development. The assistance would include design and production information, master gauges and tools, and training.[126]

Boeing wanted technical assistance agreements with Douglas and Lockheed that would compensate it with a percentage of the profit received by the two companies under their contracts with the government. Boeing and Lockheed quickly concluded an arrangement along these lines. Douglas, however, opposed compensating Boeing with a percentage of its profit, arguing instead that the expense be counted as a reimbursable cost.[127] The heart of the dispute, Allen wrote to McCone, was "who stands the cost of Boeing's compensation—the Government or Douglas."[128]


John A. McCone, under secretary of the Air Force, 1950–1951; chairman of the Atomic Energy Commission, 1958–1961; and director of the Central Intelligence Agency, 1961–1965. Courtesy, Special Collections, U.S. Air Force Academy Library.

During a meeting with McCone at the company's Santa Monica, California, headquarters late in January 1951, Donald Douglas conceded that Boeing should be compensated, but he also pointed out that it might be "exceedingly embarrassing" to the Air Force and to the aircraft industry should that compensation come from a percentage of his company's profit. Douglas reminded McCone that the government had always asserted the right, once a design had been purchased, to select any manufacturer it chose. Without granting the validity of the government's contention, Douglas noted that, based upon that argument, critics would likely find compensation provided to Boeing via the Douglas contract as unnecessary. In other words, compensation to Boeing for technical assistance provided to Douglas should be a matter of negotiation between Boeing and the government.[129]

To resolve the problem, McCone met with Douglas, Lockheed's Gross, and others early in February. The participants reached a consensus on several issues. All recognized that division of profits in order to compensate a company for providing technical assistance might result in criticism from the attorney general (concerned about antitrust implications), the General Accounting Office, and Congress. The manufacturers also agreed that compensation provided to Douglas and Lockheed, the licensees, should be somewhat less than that provided to Boeing, the licensor. Such a reduction would enable the government to compensate the licensor for technical assistance without at the same time increasing the overall cost of the article to the government with respect to profit allowed.[130] Following the meeting, the Air Force rapidly established a policy regarding compensation for technical assistance—payment for such costs would be arranged by contract between the government and the original designer.[131]

To coordinate the joint manufacturing effort, the Air Force established the B–47 Production Committee. Comprised of representatives from the Air Force and from the three production contractors, it was modeled after the industry integration committees employed by the Army Air Forces during World War II. Among the most successful of these—perhaps fortuitously for B–47 production—was the BDV organization (Boeing, Douglas, and Vega, a Lockheed subsidiary), that had manufactured the B–17. The wartime BDV committee had addressed problems associated with the concurrent production of that aircraft and had set up procedures to handle them.[132]

Despite many similarities, the B–47 Production Committee differed from its World War II predecessor in an important respect. The BDV committee's decisions were always unanimous. AAF members moderated or arbitrated disputes among the manufacturers to achieve consensus. In contrast, on the B–47 Production Committee, the Air Force enjoyed veto power and its representatives played a clear leadership role, chairing not only the main committee but also its numerous subcommittees.[133]

The reason for the change stemmed from the Department of Justice's hostility to cooperation among industrial competitors that might restrain trade and violate antitrust legislation. To prevent illegal combinations, the Department of Justice insisted that industry committees must be organized and directed by government employees—indeed they were to be known as "industry advisory" rather than "industry integration" committees. Although the Air Force alerted Boeing, Douglas, and Lockheed in December 1950 that it intended to establish a coordinating committee for the B–47, the group did not begin to function until July 1951 because of the objections posed by the Justice Department.[134]

Resolution of the dispute over compensation for technical assistance and the creation of a coordinating mechanism had cleared the way for the broadened production effort that the government desired. But B–47s would not begin to emerge from Douglas and Lockheed plants until 1953.[135] In the meantime, the focus would be on Wichita, where B–47 production had begun early in 1950.

During the first two years of acceleration, from mid-1950 through mid-1952, the B–47 program fell far short of matching the Air Force's early expectations. The April 1951 schedule had called for 967 B–47s to be produced through FY 1952, but by the end of the fiscal year in June, only 216 had been manufactured.[136] Worse yet, not one of those aircraft was combat ready. In fact, the first combat-ready B–47s did not reach the Strategic Air Command until October 1952. Only in June 1953, when the first fully equipped B–47 wing deployed to England on a 90-day training mission, could it truthfully be said that the Stratojet was prepared to fulfill its deterrent and wartime roles.[137]

Along with hindering SAC's ability to carry out the strategic air offensive, shortfalls in the B–47 program were also politically embarrassing to the Air Force. To meet the national emergency, the Truman administration had asked for and received appropriations for the Department of Defense triple those of preceding years. Congress expected to see results in terms of numbers of weapon systems produced. In turn, the Office of Defense Mobilization, the agency established by the administration to direct rearmament, pressured the Defense Department to meet production schedules (see chaps. 3 and 5).

In response, Air Force leaders leaned heavily on Boeing to meet delivery schedules. As early as March 1951, the Air Materiel Command had indicated that the B–47 program would slip about sixty days. Under Secretary McCone reported that he told Wellwood Beall, Boeing's vice president for engineering and sales, that the loss of two months' production would have serious consequences: ". . . we will have to get along with about one and a half less groups [wings] of medium bombers during a very critical time. This is an alarming fact and will not be tolerated."[138] Beall explained that Allen, the company's president, had instructed him "to go to Wichita and to do everything possible to re-establish the original schedule and to utilize Boeing's complete manufacturing capacity to this end if necessary."[139] But by late summer 1951, the situation had worsened and Boeing was in a defensive posture. "Don't ask me about the B–47 schedules," wrote J. E. Schaefer, vice president and general manager of the Wichita division, to General Hoyt Vandenberg, Spaatz's successor as chief of staff, "all I can tell you [is] we have problems aplenty and are workin' like hell to overcome them."[140] At the end of the year, when asked by Boeing to address its plant supervisors, General Curtis LeMay, SAC's commander, "replied that he didn't think they would like what he would have to say."[141]

All new aircraft, of course, encounter development and production difficulties. But such problems were magnified in the B–47 program because quantity production began before development had advanced far enough to stabilize the aircraft's design, thus facilitating manufacture. In fact, design standardization did not occur until April 1953, beginning with the manufacture of the 731st aircraft. Prior to that point, almost 3,000 engineering changes had been made to the B–47.[142]

By the end of 1951, there indeed had been "problems aplenty" with the B–47 Stratojet—more than 95 were classed as major problems and 44 of those as critical. The primary difficulty was the inability of some of the aircraft's subsystems to keep pace with its airframe and engine development. The imbalance was particularly true of two key subsystems—bombing and navigation, and defensive armament. Both incorporated advanced technologies and were still under development when quantity production of the B–47 began. Without them or at least satisfactory substitutes, the aircraft would not be ready for combat.[143]

The K–2 radar bombing and navigation system enabled the B–47, flying at high speeds and altitudes, to deliver bombs accurately on their targets. The system, weighing 1,600 pounds and comprised of 20,000 separate parts, including 370 vacuum tubes, broke down frequently and was hard to maintain.[144] The vacuum tubes were especially unreliable. Sylvania and General Electric were developing improved tubes, but had fallen well behind schedule in mid-1951.[145] Not until mid-1952 did the K–2 begin to perform at a minimum acceptable level; even so, the Air Force continued to experience difficulties with the system.[146]

The Strategic Air Command, faithfully adhering to traditional Air Force doctrine that the bomber would always get through because it could defend itself, insisted that the B–47 be equipped with defensive armament. In 1946, the Emerson Electric Company had begun developing an advanced fire control system for the B–47 consisting of radar-directed twin guns located in a tail turret that could be operated from the co-pilot's station (thus eliminating the need for a tail gunner). But the Emerson A–2 fire control system encountered so many development problems that in the fall of 1951 the Air Force decided to cancel it in favor of a comparable system, the General Electric A–5. The A–5, however, would not be ready until 1953.[147] According to General LeMay, the B–47 "would be no good for combat at all" without defensive armament.[148] Thus, to fill the void, the Air Force chose to install a less capable interim system—a twin-gun tail turret, still remotely controlled from the co-pilot's station, but with an optical sight.[149]

In addition to the bombing and navigation and fire control systems, problems with other major subsystems and components delayed production and combat-ready status for the B–47. Among these were the aircraft's aerial refueling equipment, autopilot, bomb racks, canopy, drag parachutes, ejection seats, fuel system, landing gear, and rocket assisted takeoff system.[150] In many cases, equipment did not perform satisfactorily at the B–47's high operating speeds and altitudes. For example, landing gear, when extended, malfunctioned at more than 200 mph indicated air speed.[151] Boil-off of the standard JP–3 fuel was so extensive at higher altitudes that it reduced the B–47's 2,100-mile combat radius by as much as 20 percent—a critical factor in SAC's ability to execute the strategic air offensive.[152]

In 1952, another problem with the B–47's fuel system—the fuel tanks—brought the already tense Boeing–Air Force relationship to a crisis point. A dispute between the two over who should be responsible for correcting the deficiency eventually mushroomed into a wide-ranging Air Force critique of Boeing's overall performance in the B–47 program.

Fuel for the B–47 was stored in the center sections of the aircraft's wings in bladders manufactured by Goodrich and the U.S. Rubber Company, two of Boeing's subcontractors. The Goodrich fuel tank had developed leaks. In the summer of 1951, Boeing recommended and the Air Force directed the replacement of all previously installed Goodrich fuel bladders with the apparently superior U.S. Rubber product. Over the next year, however, the U.S. Rubber fuel tank also began to leak. In August 1952, after a B–47 accident in which a malfunctioning fuel system was thought to be a possible cause, the Air Force grounded all of the Stratojets pending the outcome of an investigation.[153]

As part of the inquiry, Lt. Gen. Orval Cook, the Air Force's deputy chief of staff for materiel, wrote Boeing's president, asking him to "personally review" the fuel tank matter.[154] Allen informed Cook that the company already had a study under way to see what it could do to solve the problem, but "as you know, the responsibility [for the situation] is divided between the vendor [U.S. Rubber Company], the Air Force, and Boeing."[155]

Lt. Gen. Orval R. Cook, deputy chief of staff, materiel, U.S. Air Force, 1951–1954.

In reply, Lieutenant General Cook claimed to be "quite astonished" at Allen's assertion of three-way responsibility for the condition of the B–47 fuel tanks. Rejecting this interpretation completely, Cook affirmed Boeing's obligation to correct the deficiencies. He reminded Allen that on prior occasions the aircraft manufacturer himself had said the prime contractor "should be responsible for the quality of his product." Although gratified that Boeing was hard at work on a solution, Cook also thought the effort was "very, very belated." A "deeper feeling of responsibility" on Boeing's part, he told Allen, "would have . . . forestalled the embarrassing situation we find ourselves in today."[156]

Considering the sharp, even gratuitous, criticism leveled by Cook, Allen's response was a remarkably temperate defense of the position that the prime contractor could not be held solely to blame. He first denied that Boeing was trying to evade its "proper responsibilities" and suggested that making such determinations was more difficult than Cook suspected. Allen then went on to illustrate his contention that the government, the prime contractor, and the subcontractor shared a mutual responsibility. The Air Force, he pointed out, had been intimately involved with fuel tank development from the start. It drew up the specifications, tested and approved product samples from each bidder, and then tested and approved the low bidder's prototype. Additionally, Air Force officials and representatives of the prime contractor had both conducted inspections at subcontractor plants. But effective quality control was difficult because the subcontractors considered their manufacturing processes to be proprietary information. Consequently, government and prime contractor inspectors were entitled to check only the finished product and could identify only major defects. Since most of the fuel tank problems appeared to be detail defects, the subcontractor was in the best position to locate them. Allen also rejected Cook's insinuation that Boeing had not pursued fuel system problems aggressively. In fact, he asserted, many company-initiated fuel system improvements "have been underway for many months and are being vigorously carried out."[157]

Allen's letter so angered the Air Force that General Vandenberg signed the reply. As the recipient of more than $10 billion in contracts, lectured the chief of staff, Boeing bore a "tremendous responsibility not only to the Air Force but [also] to the people of the United States." The company's "inescapable" obligation, he wrote, was to "insure the marriage of Air Force furnished equipment with Boeing procured equipment in the complete end-product—an operational bomber—when delivered to Air Force tactical organizations." According to Vandenberg, Boeing had not lived up to this responsibility because it had not provided sufficient engineering support to solve problems associated with the fuel, engine oil, and electrical power systems as well as other deficiencies. In these instances, he asserted, Boeing management had responded too slowly, reluctantly, or not at all.[158]

Despite the harsh criticism, Allen did not retreat from his position that the responsibility was not solely or even largely Boeing's, but should also be shared by subcontractors and the Air Force. Vandenberg had charged that inadequacies in the electrical system installed by Boeing were the major reason for difficulties being experienced with the K–2 bombing and navigation system. Allen countered that, on the contrary, the electrical system was "a most excellent illustration of the troubles that result from the mixture of Air Force, airplane manufacturer and accessory manufacturer's responsibilities." He stated that problems with the alternating current system, for example, resulted from components "being procured by the Air Force to specifications which do not meet the airplane's requirements."[159]

General Hoyt S. Vandenberg, chief of staff, U.S. Air Force, 1948–1953.
Courtesy, Special Collections, U.S. Air Force Academy Library.

Vandenberg dismissed such arguments as irrelevant. It did not matter, he wrote Boeing's president, whether the deficiency involved either government or contractor furnished equipment. In his view, Allen must instill in Boeing's management the concept of responsibility for "a complete airplane—fully operational and ready to accomplish its intended mission—rather than just the delivery of a satisfactory airframe."[160]

Meanwhile, to turn "airframes" into combat-ready aircraft, early in 1952 the Air Force had initiated a modification program that may have added as much as 10 to 25 percent to the B–47's cost.[161] Subsystems that had not been ready for incorporation in aircraft being assembled were installed at special postproduction modification centers such as the one operated by the Grand Central Aircraft Corporation in Tucson, Arizona.[162] SAC, as noted previously, had begun receiving the first of the modified and combat-ready B–47Bs in October 1952.[163] With the manufacture of the 399th B–47B early in 1953, the Air Force designated subsequent production articles as the B–47E. Aircraft in the new configuration came off the assembly line equipped not only with the subsystems that had been installed in the B–47B during modification but also with other improvements.[164] By mid-1953, B–47 production was back on track.[165]

The B–47 program remained on a steady course after mid-1953, but opinion within the Air Force was divided with respect to what had gone wrong after quantity production began. General Vandenberg had blamed Boeing for failing to address the aircraft's engineering problems aggressively. His letters accurately reflected the attitude of the Air Force agencies most concerned with production—the Air Materiel Command and the Office of the Deputy Chief of Staff for Materiel—as well as that of the ultimate user of the B–47, the Strategic Air Command.[166]

B–47 assembly line, Boeing plant, Wichita, Kansas, February 1954.

A different perspective came from advocates of the weapon system approach to aircraft acquisition, located mostly in the Air Research and Development Command and in the Office of the Deputy Chief of Staff for Development. In their view, "[t]he original B–47, rushed into production before undergoing a systematic development-test cycle, accentuated the fallacies of a management philosophy that stressed collections of components rather than an integrated combat-ready aircraft."[167] Several scholars have subsequently adopted this interpretation.[168]

B–47A rocket-assisted take off.
Courtesy, National Museum of the U.S. Air Force.

In a study of Air Force bomber acquisition following World War II, Michael Brown challenges the notion that early application of the weapon system concept in the B–47 program would have prevented many of the problems that surfaced when quantity production began. He points out that meaningful subsystem development could not proceed until the B–47's aerodynamic performance—capabilities that exceeded initial predictions—was well understood. In any case, Brown notes, the Air Force had not neglected subsystem development as critics charged. In fact, work had begun on defensive armament for the B–47 in 1946. But as with the jet-powered, swept-wing airframe itself, the remotely controlled, radar-directed fire control system also pushed the state of the art and was not ready to be installed in B–47Bs that rolled off the assembly line in 1951. The B–47 ran into difficulty, he concludes, not because the Air Force failed to develop airframe and subsystems concurrently but because it abandoned the sequential acquisition strategy that had proved so successful before the program was accelerated and quantity production initiated in late 1950. At that time, the B–47A had made its first flight only a few months previously and the B–47B—the production version of the aircraft—had yet to fly. As Brown puts it: "The decision to accelerate the B–47 program—to insist that development and production take place concurrently—was a prescription for disaster."[169]

If, as Brown argues, an inappropriate concurrent development strategy was the principal reason for such a poor start to B–47 production, then the Air Force wrongly faulted Boeing. Although the company had assumed responsibility for integrating the B–47's subsystems with the airframe, it had little prospect of success if they were still in the development stage. Writing to Secretary of the Air Force Finletter in September 1950, just as the B–47 program was being accelerated, Wellwood Beall, Boeing's vice president, correctly identified what would prove to be the major obstacle to producing a combat-ready aircraft under such circumstances: "The mechanical difficulties that keep an airplane on the ground are usually [the] malfunctioning of installed equipment, such as engines, bomb sights, gun fire control, etc. If only tried and true equipment is installed in the aircraft, earlier combat operational status will be achieved. . . ."[170] But Boeing wanted the big B–47 production contract and the Air Force wanted the jet bomber quickly. So both headed into trouble.

EMPLOYMENT OF RETIRED MILITARY OFFICERS IN INDUSTRY

In July 1948, Maj. Guy Townsend became the first Air Force officer to fly the XB–47 prototype. Together with Boeing's civilian pilots, he put the experimental aircraft through flight testing at Moses Lake Air Force Base in eastern Washington. About two years later, Townsend also co-piloted the Boeing-built B–52 prototype on its maiden flight. From aircraft testing and evaluation, Townsend then went on to hold other jobs in acquisition, including director of the system program offices for the Air Force's C–5 transport and the B–1 bomber. In 1970, Brigadier General Townsend retired from the Air Force and went to work for Boeing, reflecting a practice that had become commonplace since the end of World War II.[171]

When Townsend became a military test pilot in 1945, relatively few retired military officers were employed in defense industries. From then on their numbers mushroomed. By 1959, 750 senior officers (colonels or generals, or captains and admirals if in the Navy) who had retired from the military were listed on the rolls of such companies.[172]

A decade later, just before Townsend left the Air Force, the top 100 defense contractors were employing almost 2,100 officers who had retired in those ranks.[173] Between 1971 and 1979, nearly 1,500 such senior officers obtained employment in defense work.[174] By the 1980s, the flow of retired officers into industry—along with the parallel movement of civilian executives from defense firms into high-level government positions—had come to be called the "revolving door." [175]

Critics have attacked the revolving door from two angles. One focus has been on the potential for conflicts of interest that might undermine the integrity of the acquisition process. For example, an officer nearing retirement and able to influence contract negotiations or awards might be strongly tempted to favor a prospective employer.[176] Another challenge has come from those who view the intermingling of government and private-sector leadership as symptomatic of a "permanent war economy" that threatens democracy.[177]

In the late 1940s, the Air Force slowly began to confront issues associated with the revolving door. Ambivalence best characterizes its attitude. On the one hand, Air Force leaders believed that acquisition programs would benefit if retired officers occupied key management positions in companies developing and producing critical weapon systems. On the other hand, they also recognized that suspicions were aroused when firms doing business with the Air Force employed retired officers.

Lt. Gen. Ira C. Eaker, deputy commander, Army Air Forces, 1945–1947.

During World War II, the Army Air Forces had paid close attention to how well aircraft companies were being run. When Assistant Secretary of War for Air Robert Lovett suspected that a firm's poor performance resulted from mismanagement, he demanded changes in its leadership.[178] After the war, Air Force officials looked upon retired senior officers as an excellent source of skilled and experienced managers for the industry even though they might lack experience in acquisition or in industrial management. For their part, company executives anticipated that hiring retired generals might help obtain government contracts.

In 1947, Howard Hughes, pioneer aviator and owner of the Hughes Tool Company, scored a coup when he hired two retired officers, Lt. Gen. Ira Eaker, formerly deputy commander of the Army Air Forces, and Lt. Gen. Harold L. George, who had directed the Air Transport Command during the war. Eaker became vice president of Hughes Tool, headquartered in Houston, Texas, and served as liaison with the company's aircraft division, Hughes Aircraft, in Culver City, California. George was named vice president of the aircraft division and ran its day-to-day operations.[179] Addition of the two generals to his management team soon paid off for the eccentric

Lt. Gen. Harold L. George, commanding general, Air Transport Command, 1942–1945.

multimillionaire. In mid-1948, in recommending to the under secretary of the Air Force that missile development contracts be approved for Hughes Aircraft, the acting deputy chief of staff for materiel asserted that "under the able guidance" of Eaker and George, "a continuing, firm, and steady policy of administration within the Company will result."[180]

HOWARD HUGHES AND THE AIR FORCE

The managerial abilities of retired generals Ira Eaker and Hal George notwithstanding, the increasingly remote and enigmatic Howard Hughes so alienated the top people at Hughes Aircraft that many left the company in the early 1950s. They included George and the company's top engineers, Simon Ramo and Dean Wooldridge, who struck out on their own to form the Ramo-Wooldridge Corporation, which after merging with Thompson Products became TRW in 1958 (see chap. 9).

So concerned was the Air Force about the management turmoil at Hughes, prime contractor for the F–102's fire control system and the Falcon air-to-air missile, that Under Secretary of the Air Force Roswell Gilpatric warned the incoming Eisenhower administration's Air Force civilian leadership that it might be necessary "to intercede in this internal management squabble in order to prevent this very important unit in the aircraft electronics industry from losing the momentum it has built up over the past several years."

In September 1953, the new secretary of the Air Force, Harold E. Talbott, met with Howard Hughes in Los Angeles. According to one source, Talbott angrily told Hughes that he had made "a hell of a mess of a great property and by God, so long as I am Secretary of the Air Force, you're not going to get another dollar of new business." Hughes was given 90 days to find leadership for the company that would be acceptable to the Air Force. He quickly complied.[III]

Before long, the association of retired officers with aircraft manufacturing firms showed signs of becoming a two-edged sword. Early in 1949, the Air Force awarded a production contract for a new trainer aircraft to the Fairchild Engine and Airplane Corporation. Fairchild's design was chosen in a competition that also included entries from the Beech Aircraft Corporation and the Texas Engineering and Manufacturing Company (Temco).[181] Beech angrily protested the Air Force's decision. In addition to maintaining that its design was superior, the company charged that factors other than product quality had influenced the outcome. Beech's vice president and general manager, John P. Gaty, claimed the company lost the contract because of collusion between Brig. Gen. Kenneth P. McNaughton, the director of training and requirements on the Air Staff, and retired Maj. Gen. W. W. Welsh, then employed by Fairchild. According to Gaty, McNaughton had once told him that Fairchild's design evolved from a concept that he, McNaughton, and Welsh had developed during World War II. Another reason for Beech's unsuccessful bid, asserted Gaty, was that the company "made no attempt to hire officers to counter the influence of ex-Air Force generals employed by competitors."[182] In following this policy, Gaty suggested, he was simply heeding Secretary of the Air Force Symington's warning, given to the aircraft manufacturers at the Aircraft Industries Association conference at Williamsburg in 1948, not to employ retired officers in sales positions.[183]

Within a few months the Air Force reversed itself, deciding not to produce the Fairchild aircraft but instead to overhaul the T–6, the trainer already in the inventory. The reason for the about face, according to the assistant deputy chief of staff for materiel, was that the number of new pilots to be trained annually had been cut in half. The modified T–6 could meet the reduced requirement and at much less cost. While sticking with the T–6 for the time being, the Air Force also planned to purchase prototypes from Beech, Fairchild, and Temco for extensive service testing prior to selecting one for quantity production.[184]

No evidence has been uncovered to indicate that the Air Force's initial selection of the Fairchild design had anything to do with the Welsh-McNaughton relationship. Similarly, there is no proof that the Air Force decided not to produce the Fairchild trainer as a result of Beech's allegations. Nevertheless, the incident illustrated how "revolving door" connections might poison the acquisition atmosphere.

The Beech affair did not attract public attention. But in the latter half of 1949, another instance of allegations of inappropriate behavior associated with the revolving door was very much in the spotlight. In late May 1949, charges surfaced in Congress that Secretary of Defense Johnson and Symington had wrongly used their positions to influence the Air Force's purchase of Convair's long-range B–36 bomber over Northrop's B–49 and Boeing's B–54.[185]

Before becoming secretary of defense, Johnson had been a director and Washington-based counsel for Convair, whose president was Floyd Odlum. Symington also knew Odlum, both professionally and socially. According to one of the allegations, Symington had been conspiring with Odlum to create "a huge aircraft combine," entailing a merger of Northrop and Convair, that the Air Force secretary would direct after leaving government service.[186]

The accusations, contained in an anonymous document prepared by a civilian official in the Navy Department, closely followed Johnson's peremptory cancellation of the Navy's supercarrier, *United States*, in April 1949.[187] Navy leaders believed the huge warship would enable it to cut into the Air Force's monopoly of the strategic bombing mission and were understandably angered by Johnson's decision. Extensive congressional hearings into procurement of the B–36, the decision to cancel *United States*, and the effectiveness of strategic bombing captured public attention during the summer and fall of 1949. As a result of the investigation, the House Armed Services Committee cleared both Johnson and Symington of the allegations of unethical conduct. But the whole affair had long-term effects.

After the difficulties with Beech and the charges against Symington in 1949, the Air Force became more cautious concerning its position with respect to the employment of retired officers in industry. It continued to support the practice, but did so circumspectly and with a greater sensitivity to the potential for apparent conflicts of interest to create unfavorable publicity. Defense contractors did not seem to be affected by such considerations. One business journal succinctly characterized their attitude: "What branch of government spends the most money? The military. Who . . . is an expert on red tape? A general or an admiral. So make him Chairman of the Board."[188]

In the spring of 1951, the Chase Aircraft Company attempted to hire two high-ranking Air Force generals who were about to retire. The move was a blatant example of such expediency. As noted earlier, Chase had developed the XC–123, an assault transport that loaded easily and could operate from short, undeveloped airfields.[189] These capabilities made the aircraft well-suited to support Army forces, one of the Air Force's missions. The service planned to buy at least 300 C–123s but was reluctant to award the contract to Chase, primarily because of doubts that the company could manufacture that many at its relatively small plant in West Trenton, New Jersey.[190] Another reason for hesitating may have been indications of poor relationships among Chase's top managers, especially between Mike "The Mad Russian" Stroukoff, the company's colorful founder, chairman of the board, and president, and its vice president John F. Ryan.[191]

Early in March 1951, Stroukoff met with K. B. Wolfe, now a lieutenant general and the deputy chief of staff for materiel on the Air Staff, and presented a plan that he hoped would overcome the Air Force's reservations. The proposal entailed initiating production at Trenton, acquiring financial backing to generate additional manufacturing capacity at a plant that Chase had leased in Birmingham, Alabama, and making radical changes in the company's top leadership.[192]

Under the reorganized management structure, General George Kenney, then commander of the Air University and formerly commander of the Strategic Air Command, would become the chairman of the board. Lt. Gen. Elwood R. Quesada, assigned to the Joint Chiefs of Staff organization and formerly head of the Air Force's Tactical Air Command, would become president. Stroukoff would step down to the position of chief engineer. Neither general had yet retired, but negotiations for their employment were nearing completion. According to Stroukoff, Quesada had agreed to become president effective 1 July 1951, and Kenney had been offered but had not yet formally accepted the board chairmanship.[193]

Of the two generals, only Kenney possessed experience in aircraft development or production.[194] But reasons other than acquisition expertise probably explain Stroukoff's eagerness to employ the officers. Quesada was a strong proponent of tactical air power and close cooperation between the Air Force and Army.[195] Kenney had been General Douglas MacArthur's air commander in the Pacific during World War II, had spoken widely and effectively on behalf of an independent Air Force after the war, and was well known publicly.[196]

Lt. Gen. Kenneth B. Wolfe, deputy chief of staff, materiel, U.S. Air Force, 1949–1951.

Stroukoff did not appear to care how offering jobs to general officers still on active duty in order to secure a large Air Force contract might look. But given the negative publicity for the Air Force that resulted from the charges leveled against Symington less than two years before, Kenney's and Quesada's participation in negotiations for employment under such circumstances—even if their current positions had nothing to do with acquisition—is hard to fathom.

In contrast to Stroukoff and the two generals, then Maj. Gen. Orval Cook, the officer responsible for contracting at the Air Materiel Command, had a much firmer grasp of reality. He recommended to Lieutenant General Wolfe that the Air Force not let Chase build the C–123, primarily because "[w]e cannot afford to experiment with a producer whose record of accomplishment, from an economic standpoint is poor."[197] Cook also thought it "would be very unwise for any ex-Air Force officers to become associated with Chase."[198] For one thing, he doubted that they would be able to contribute much initially to the enterprise. Moreover, he warned Wolfe, "the accusation would certainly be made that undue influence had been exercised."[199]

In the end, neither Kenney nor Quesada went to work for Chase, but Stroukoff still found a way to win the C–123 contract.[200] In May 1951, the Kaiser-Frazer Corporation, then doing poorly making automobiles, sought to make up the deficit in aircraft manufacturing. Having purchased the giant Willow Run aircraft assembly plant outside of Detroit, Michigan, from Ford, Kaiser-Frazer bought 49 percent of Chase's stock. Henry Kaiser then became president of the company, Stroukoff stayed as chief engineer, and the Air Force awarded Chase the contract to build the C–123. Kaiser-Frazer, however, proved to be no more successful at making airplanes than it had automobiles. In 1953, the Air Force terminated the contract due to unsatisfactory performance and re-awarded it to Fairchild.[201]

Thompson Products (the "T" in TRW Inc. after its merger with the Ramo-Wooldridge Corporation in 1958), was another defense contractor that seemed to be indifferent to the appearance of wrongdoing in dealing with the Air Force during the early 1950s. Headquartered in Cleveland, Ohio, Thompson manufactured components for automobile and aircraft engines. When the Air Force began to expand during the Korean War, Thompson's jet-engine blades were much in demand.[202] In March 1951, the company informed the Air Force that it would share voluntarily "tricks of the trade" with other companies so that additional sources for making the component could be developed rapidly.[203] And, in fact, Thompson moved expeditiously to distribute the information.[204]

The Air Force was grateful to Thompson for making proprietary information available, but not pleased that, at about the same time, the company had offered a job to Brig. Gen. Horace A. Shepard, who was assigned to the Air Staff's Office of the Deputy Chief of Staff for Materiel and responsible for headquarters oversight of procurement.[205] The Air Force refused to release Shepard from the service. Under Secretary of the Air Force McCone explained to Frederick C. Crawford, Thompson's president, that losing Shepard "at this time would very seriously impair our program."[206] Crawford agreed to "put the matter on ice" until the national emergency had become less acute.[207]

The generosity and cooperative spirit exhibited by Thompson Products may not have been motivated entirely by patriotism. The company appealed to the Air Force in May 1951 for help in persuading the Federal Trade Commission to postpone hearings scheduled in a suit brought against Thompson involving violation of antitrust laws in connection with the sale of automobile products. Air Force officials were sympathetic to Thompson. Lieutenant General Wolfe thought the "diversion of time and effort of top executives at this critical juncture" to defend their companies in such proceedings "cannot help but effect [sic] the [Air Force's procurement] program."[208] Nevertheless, the Air Force would not go as far as Thompson wanted. Under Secretary McCone asked the Federal Trade Commission only to extend "whatever leeway may be necessary in the scheduling of hearings and the calling of witnesses so that there will be no serious interference with the defense production work being carried out by the Company."[209]

Although unwilling to back Thompson's request to put off the antitrust suit, the Air Force released Brigadier General Shepard much sooner than earlier had seemed likely. At the beginning of September 1951, Shepard resigned his commission (unusual for a general officer), and was hired by Thompson Products.[210]

Shepard's departure from the Air Force and his employment by Thompson attracted attention in Congress. Both Senators George A. Smathers of Florida and Lyndon B. Johnson of Texas requested Air Force Secretary Finletter to supply information about Shepard's resignation. Johnson, chairman of the Preparedness Investigating Subcommittee, wanted Shepard's personnel file "together with a full explanation of why a general so young in years was permitted to resign at this time, and pertinent information respecting the General's subsequent employment by the firm of Thompson Products, Incorporated."[211] It is probable, of course, that Johnson was much less concerned with the loss of a young officer during a period of national emergency than he was with the loud noises being made by the revolving door.

Shepard had been preceded through the door to defense industry employment by his supervisor at Air Force headquarters, Lieutenant General Wolfe, the deputy chief of staff for materiel. At the end of June 1951, two months before Shepard resigned, Wolfe retired. At the end of August, he became president of Oerlikon Tool & Arms Corporation of America, a subsidiary of Oerlikon Machine Tool Works, Buehrle & Company, a Swiss armament manufacturer. Wolfe's association with Oerlikon, a relationship that began while he was on active duty, caused the Army to question the integrity of Air Force acquisition.

Wolfe's contacts with Oerlikon began shortly after the outbreak of the Korean War. Air-to-ground rockets fired by Air Force aircraft would not penetrate the Soviet tanks used by North Korean forces. Learning that Oerlikon had developed a rocket with sufficient armor-piercing capability, Wolfe assigned a high priority to obtaining some to test. Sometime before the end of July 1950, he also met with Oerlikon's owner in Washington, D.C.[212]

In addition to air-to-ground rockets, the Air Force was interested in other armament products developed by Oerlikon and other European firms. In the fall of 1950, accompanied by officers from the Air Staff and from the Air Materiel Command, Wolfe traveled to Europe to examine the weapons. One of the stops was at Oerlikon's headquarters in Zurich.[213] Early in 1951, Wolfe's deputy informed the commander of the Air Force's Air Proving Ground Command that "General Wolfe has taken steps on his own to procure from Switzerland certain guns and ammunition for purposes of evaluation at the Armament Test Center."[214]

The shortcomings in air-to-ground rockets that prompted the turn to European manufacturers confirmed what Air Force officials had known for some time—the service's aircraft armament program was inadequate. Some attributed the deficiencies to dependence on the Army, whose Ordnance Corps developed and produced guns and rockets for Air Force aircraft mostly in government arsenals.[215] The Air Force thought that greater use should be made of private industry. According to one Air Force report, reliance on military arsenals "has resulted in armament lagging far behind the development of air frames, engines, and accessories that comprise an integrated air weapon system."[216]

Wolfe was determined to wrest control of armament acquisition from the Army. On 15 May 1951, about six weeks before he retired, Wolfe recommended to General Vandenberg that the Air Force "should immediately assume full responsibility for research, development, test, and procurement of essential armament items, using Ordnance facilities only when required."[217] In addition, Wolfe suggested that "[p]rocurement of these items should be placed with industrial concerns who indicate a present interest and a continuing desire to remain in this type of engineering and production business."[218] In response, Vandenberg wrote: "For two years now I have been hammering on our lack of progress in the Armament field and we have had several meetings on this subject. You now tell me that the situation is quite unsatisfactory and that something must be done about it. I agree completely."[219]

It is highly probable that Wolfe had Oerlikon in mind when he referred to firms "who indicate a present interest and a continuing desire to remain in" the field of aircraft armament manufacture. Indeed, from the outset, the company let Department of Defense officials know that it was eager to accommodate the American military. In September 1950, Oerlikon's owner told the under secretary of the Army and the under secretary of the Navy that he was willing to finance construction of a plant in the United States to produce materiel desired by the armed forces. Wolfe undoubtedly knew this before visiting Oerlikon's facilities in Zurich in the fall of 1950.[220] In a letter to Wolfe dated 16 May 1951 (one day after Wolfe had sent the letter to Vandenberg), Oerlikon reaffirmed its intention to set up an armament manufacturing plant in the United States. The company indicated that it would also establish an armament research and development operation.[221]

Six weeks later Lieutenant General Wolfe retired from the Air Force, becoming president of Oerlikon Tool and Arms Corporation of America on 31 August. In mid-March 1952, true to its word, Oerlikon began to build a combined armament research and development and production facility on a 1,800-acre site near Asheville, North Carolina.[222]

Whether Wolfe realized it or not, assuming the presidency of Oerlikon's operations in the United States would endanger what presumably had been his original objective for cultivating a relationship with the company—obtaining the best possible armament for Air Force aircraft. Lieutenant General Cook, who succeeded Wolfe as deputy chief of staff for materiel, recalled that the Ordnance Corps refused to buy Oerlikon's air-to-ground rockets for the Air Force. "They had a lot of reasons why," he remembered, "and one of them was that General Wolfe, after he retired, became president of the American Oerlikon."[223] Cook took the problem to Under Secretary of the Air Force Gilpatric. The two then met with the secretary and under secretary of the Army, and Ordnance Corps officials. "We had quite a heated argument about this," Cook stated, "and I told them that I didn't give a damn who made the rocket [or] who sold the rocket; if we had to buy it from the devil and it would poke holes through Russian tanks, I wanted some of them, and the pilots wanted them."[224] According to Cook, when the Army's civilian leaders found out that the Ordnance Corps would not have a comparable rocket ready for a year and a half, they agreed to let the Air Force purchase large quantities of the Oerlikon rocket.[225]

Although yielding on air-to-ground rockets, the Army still resisted Air Force attempts to obtain independence in armament acquisition and used Wolfe's close relationship with Oerlikon as a weapon in the bureaucratic battle. In preparing its position for presentation to the secretary of defense, the Air Force hoped to avoid the controversy surrounding Wolfe. General Nathan Twining, the vice chief of staff, advised key subordinates putting together the Air Force's case: "I think it essential that we not permit the question of Oerlikon and the association with that company of Lieutenant General Wolfe to obscure the major issue. Air Force lack of control during the past of armament research, development and production has lead to the present unsatisfactory armament situation throughout the Air Force."[226]

In accepting employment with Oerlikon, a company whose products he had promoted while on active duty, Wolfe ignored appearances and hurt the Air Force. His actions called into question the integrity of Air Force acquisition, intensified interservice rivalry, and complicated the service's effort to secure more influence over aircraft armament development and procurement.

Another result of the controversy surrounding Wolfe may have been to force high-level support within the Air Force for the employment of retired officers with defense contractors to go underground. In the fall of 1952, Lt. Gen. Leon W. Johnson, commander of the Continental Air Command, proposed to Lt. Gen. Laurence S. Kuter, the Air Force's personnel chief, that the service establish a point of contact to facilitate placing retired officers or those about to retire in jobs with industry. Kuter was pleased that Johnson offered to set up the operation at Continental Air Command headquarters at Mitchel Air Force Base on Long Island, New York. Creating such a clearinghouse at Air Force headquarters had been contemplated before, stated Kuter, but "considerations of space, time, and politics made it impracticable to undertake the job here." Kuter asked Johnson to draw up an informal statement of the operation's mission, "in terms that would be useful, especially in Washington, to encourage our retired and retiring officers, but to discourage prying questioners." But, cautioned Kuter, the mission "should not be officially recognized and perhaps should never be reduced to any specific written terms." Kuter encouraged Johnson to draw up a detailed plan, promised his strong support, and stated that he was "almost sure" that General Vandenberg and General Twining would be pleased with it also.[227]

No records have surfaced to show that anything actually came of Johnson's proposal. There is also a possibility that Kuter did not, in fact, send the letter.[228] Nevertheless, Johnson's suggestion and Kuter's response to it demonstrate that although top Air Force leaders knew that facilitating the employment of retired officers in defense industries would be questioned, they were still willing to assist quietly, even secretly.

The presence of retired officers in defense firms, particularly at upper management levels, benefited both the Air Force and industry. Retired officers generally had excellent leadership and organizational skills. All knew the Air Force and many were intimately acquainted with the acquisition process. All had access to friends and associates still on active duty that would not have been available to others. Early in 1953, for example, then-retired Lieutenant General Wolfe was able to call upon General Twining and deliver a letter expressing concern about the difficulties being experienced by Oerlikon in obtaining an export license from the Swiss government to ship air-to-ground rockets to the United States.[229] Such contacts, as well as the knowledge and skills possessed by retired officers, made the weapons acquisition process function more efficiently and expeditiously.

But whatever the advantages, the association of retired senior officers or those about to retire with defense contractors aroused suspicions that the acquisition playing field was not level. Since, for many Americans, arms development and manufacture was at best a necessary evil, the Air Force and the nation could ill afford the impression that military officers were pursuing private and not public interests. In late 1950, as billions of dollars began to flow to rearm the Air Force, General Vandenberg wrote the service's major commanders about appropriate conduct for all personnel engaged in procurement activities. "It is not sufficient," he stated, "to delineate between right and wrong, legality and illegality, but it is equally important to stress the necessity of avoiding even the *appearance* of impropriety."[230] Clearly, some general officers did not heed their chief's advice.

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In January 1961, shortly before leaving office, President Eisenhower warned Americans to be on guard against abuse of power by a combination of interests that he called the "military-industrial complex."[231] By then, cooperation between the aircraft manufacturing industry and the Air Force was the centerpiece of the phenomenon he described. Ties between the two, first forged on a large scale during World War II, became permanent after the war as the nation relied on technologically advanced aerial weapons to deter the Soviet Union. Employment of increasing numbers of retired officers in the industry—intermarriage of a sort—further cemented the bonds.

Rhetorically at least, leaders of the Army Air Forces acknowledged the industry's importance from the beginning of the postwar period. At the Pentagon in September 1945, they told the aircraft manufacturers that the service, lacking an adequate research and development or manufacturing capability of its own, would be "absolutely dependent" on the industry. And yet, the AAF's uniformed leadership, focused on operational concerns, paid little attention to aircraft manufacturing's overall condition when it recommended the allocation of production contracts in the first two years following the war. Stuart Symington had a broader perspective and prompted slight adjustments in the service's FY 1948 procurement program to better balance the distribution of contract awards.

War in Korea and the threat of war with the Soviet Union returned aircraft manufacturing to the top rank of American industries. The industry's economic and technological importance and the Air Force's dependence on it to provide advanced weapons, however, did not exactly make the two equal partners. The Air Force buyer was usually superior to the aircraft company seller in the relationship, profiting from government's power to set policies, such as patent ownership, that affected the entire industry. The Air Force also displayed dominance in one-on-one relationships with individual companies: it promoted geographic dispersal by insisting that Boeing build the B–47 in Wichita rather than Seattle; it violated precedent by awarding the production contract for the C–123 to Fairchild, rather than Chase, the system's developer; and, as in the case of Hughes Aircraft, by demanding changes in the company's management. On the other hand, the aircraft manufacturers were not simply "hired help." Donald Douglas won his fight over compensation arrangements in connection with B–47 production; Boeing did not bend when criticized by the Air Force for its handling of the B–47, even when the browbeating came directly from the chief of staff; Beech successfully protested the Air Force's award of a contract for a new trainer aircraft to Fairchild; and, by hiring retired officers, defense contractors acquired potentially fruitful sources of influence within the Air Force itself. It is probably most accurate to characterize the Air Force–industry relationship in the decade and a half following World War II as mutually beneficial, with each partner often able to take from the association more or less what it wanted.

Endnotes

1. Brochure for attendees (The Second Conference of the Board of Governors of the Aircraft Industries Association of America, Incorporated at The Inn, Williamsburg, Virginia, May 14-15-16, 1947); 24 April 1947, 14, no folder, box 60, entry 380 (Office of the Deputy Chief of Staff, Materiel; Executive Office, Administrative Branch, Miscellaneous Informational Records, 1945–1949), RG 341.
2. Ibid., 10-12. In 1948, after retiring from the Navy, Ramsey would become the president of the Aircraft Industries Association, succeeding retired Maj. Gen. Oliver P. Echols, who had been in charge of aircraft procurement for the Army Air Forces in World War II. In 1949, Echols became chairman of the board and general manager of Northrop Aircraft Corporation; subsequently he became president after a personnel dispute resulted in the resignation of John W. (Jack) Northrop, the firm's founder.
3. Ibid. The State Department representatives were the assistant secretary of state for occupied areas and the chief of the Division of Eastern European Affairs.
4. Ibid., 13.
5. Ibid., 1.
6. G.R. Simonson, "The Demand for Aircraft and the Aircraft Industry, 1907–1958," *The Journal of Economic History* 20, no. 3 (September 1960): 361, 377.
7. Donald M. Pattillo, *Pushing the Envelope: The American Aircraft Industry*, 154.
8. Charles D. Bright, *The Jet Makers: The Aerospace Industry from 1945 to 1972*, 13; and Simonson, "Demand for Aircraft," 371.
9. Simonson, "Demand for Aircraft," 361, 377.
10. The following are excellent surveys of the history of the aircraft manufacturing industry: Pattillo, *Pushing the Envelope*; Roger E. Bilstein, *The Enterprise of Flight: The American Aviation and Aerospace Industry*; Wayne Biddle, *Barons of the Sky*; Bright, *Jet Makers*; and John B. Rae,

Climb to Greatness: The American Aircraft Industry, 1920–1960.
11. Table 7 (Aeronautical Production and Sales, 1946–1958), in Simonson, "Demand for Aircraft," 378.
12. Bright, *Jet Makers*, 101-02.
13. Rae, *Climb to Greatness*, 214.
14. Robert E. Gross, "An Address Delivered at the A.I.A. Conference, Williamsburg, Virginia," 15 May 1947, 15, folder Speech File, 1947, box 15, Papers of Robert E. Gross [hereafter Gross Papers], LC, Annual figures cited in the paragraph are for calendar years.
15. Table 1 (U.S. Aircraft Production, Calendar Years, 1909–1974), in app. to Bilstein, *Enterprise of Flight*, 226-27.
16. Charles J. V. Murphy, "The Anxious Aircraft 'Primes'," *Fortune* 56, no. 3 (September 1957): 148-49, 276, 278; and Rae, *Climb to Greatness*, 214.
17. Mark Lorell, *The U.S. Combat Aircraft Industry, 1909–2002: Structure, Competition, Innovation*, 8.
18. Ibid., 172-73; and Bilstein, *Enterprise of Flight*, 81-82.
19. Eugene Gholz, "The Curtiss-Wright Corporation and Cold War-Era Defense Procurement: A Challenge to the Military-Industrial Complex Theory," *Journal of Cold War Studies* 2, no. 1 (Winter 2000): 35-75.
20. Pattillo, *Pushing the Envelope*, 174-76; and Biddle, *Barons of the Sky*, 298-308, 320-23.
21. Pattillo, *Pushing the Envelope*, 165-66, 170.
22. Lorell, *Combat Aircraft Industry*, 8-9; and Pattillo, *Pushing the Envelope*, 361-63.
23. Memo, Maj. Gen. E. M. Powers, Assistant Chief of the Air Staff-4 [Materiel], for Assistant Secretary of War for Air, 29 October 1946, sub: Consolidated-Vultee/Lockheed Merger, no folder, box 62, entry 380, RG 341.
24. Ltr, Robert E. Gross to Lynn L. Bollinger, 22 October 1946, folder Aerospace Industry, 1946, box 13, Gross Papers, LC. See also Biddle, *Barons of the Sky*, 293; Bright, *Jet Makers*, 145-46; and Frank Kofsky, *Harry S. Truman and the War Scare of 1948: A Successful Campaign to Deceive the Nation*, rev. ed., 34-35.
25. Pattillo, *Pushing the Envelope*, 152-54; and Bright, *Jet Makers*, 145-46.
26. Bright, *Jet Makers*, 147.
27. Frederic M. Scherer, "The Aerospace Industry," in *The Structure of American Industry*, 4th ed., ed. Walter Adams, 335.
28. Ibid., 366-67.
29. Simonson, "Demand for Aircraft," 380.
30. Aaron L. Friedberg, *In the Shadow of the Garrison State: America's Anti-Statism and Its Cold War Grand Strategy*, 288.
31. Ltr, I. M. Laddon, Executive Vice President, Consolidated-Vultee Aircraft Corporation, to W. Stuart Symington, Secretary of the Air Force, 29 January 1948, 4-5, folder Finletter Correspondence, box 14, entry 3 (Office of the Administrative Assistant; Correspondence Control Division; General File by Organization and Subject, 1947–1953; Special Interest File), RG 340.
32. Rae, *Climb to Greatness*, 156-57. J. Ronald Fox has clarified the relationship between contractor profits and costs from the differing perspectives of the contractor and the government: "While the Defense Department sought to maintain contractor profits at a relatively low percent of costs, the same profit amount could be a relatively high percent of a contractor's investment in an acquisition program. This often occurred when the government supplied or paid for much of a contractor's plant and equipment investment in the development and production program, and made available to the contractor a relatively high level of progress payments for the work being performed. The government, for reasons unclear, seeks to keep contractor profits low *as a percent of costs*. In sharp contrast, the private-sector marketplace focuses on contractor profit *as a percent of contractor investment*—as an indicator of a contractor's strength and profitability. This odd situation continued throughout the 20th century and

throughout the first decade of the 21st century." J. Ronald Fox communication to author, 6 December 2010. See also Fox's *Arming America: How the U.S. Buys Weapons*, 309-10; and his (with James L. Field) *The Defense Management Challenge: Weapons Acquisition*, 38-39.
33. Industry Advisory Committee on Military Contractor Relationship, *Report to the Munitions Board: Review of Major Problems in Military Procurement and Recommendations*, August 1951, 10-11, 22-31, copy in NDU Library.
34. Frederic M. Scherer, *The Weapons Acquisition Process: Economic Incentives*, 114-15.
35. Pattillo, *Pushing the Envelope*, 166.
36. Donald R. McVeigh and Robert L. Perry, with Warren E. Greene, *The Development of the F–102 Aircraft (through December 1954)*, Vol. I, 36-38, microfilm roll K 2924, AFHSO. Some Air Force acquisition officials tended to sympathize with contractors on this issue. In l946, Maj. Gen. L. C. Craigie, then chief of the engineering division at the Air Materiel Command, stated to Industrial College of the Armed Forces faculty and students that the Army Air Forces was angering contractors unnecessarily "by taking a hard-boiled attitude on patents and trying to mulct out of [force from] the contractor every bit of patent coverage and license rights which you can get him to give us." General Mark E. Bradley, who held several key acquisition assignments in the late 1940s and the 1950s, recalled in an interview: "There was a drive by a lot of governmental people and agencies in the DoD to take over rights and things from contractors. They demanded they give them all the drawings and all that stuff when they bought something. They didn't really respect it. For instance, they would go out and take these drawings and put them out to somebody else, job shop guy, to build parts for something. I thought all the time they ought to respect the contractor's rights to his products and his patent." See Maj. Gen. L. C. Craigie, "Research and Development in the Army Air Forces," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 7 October 1946, 15, NDU Library; and Mark E. Bradley, interview by Maj. Scottie S. Thompson, U.S. Air Force Oral History Program, 5–8 February 1979, Palos Verdes, Calif., 146-7, file K239.0512-1114, AFHRA; copy in AFHSO.
37. Bright, *Jet Makers*, 132.
38. Bilstein, *Enterprise of Flight*, 96; and Simonson, "Demand for Aircraft," 380.
39. Bright, *Jet Makers*, 132.
40. Edward H. Heinemann, "Problems in Aircraft Production," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 11 February 1953, 10, NDU Library.
41. D.C. Ramsey, "Aircraft Production Problems for War," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 12 February 1951, 5, ibid. For one aircraft manufacturer's overwhelmingly positive view of subcontracting, see H. M. Horner [president, United Aircraft Corporation], "Jet Engine Production," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 11 February 1952, 10-11, ibid.
42. Pattillo, *Pushing the Envelope*, 140.
43. Bright, *Jet Makers*, 132.
44. Charles J. V. Murphy, "The Wild Blue Chip Yonder," *Fortune* 52, no. 1 (July 1955): 75-76.
45. Bright, *Jet Makers*, 132.
46. Department of the Air Force, *Report of the Secretary of the Air Force to the Secretary of Defense for Fiscal Year 1948*, 191; ltr, J. H. Doolittle [special assistant to the chief of staff, U.S. Air Force] to Maj. Gen. K. D. Nichols, Chief, Research and Development, U.S. Army, 2 March 1953, folder 120.1, Funds, box 17, entry 10 (Decimal Correspondence of the Special Assistant to the Chief of Staff Relating to the Organization of Research and Development Activities), RG 341; and Research and Development Board, "Budget and Fiscal Information on Research and Development Program, FY 1952–FY 1954" (RDB 106/25), 25 September 1952, 17, folder RDB 106.7, Fiscal Year 1954, box 497, entry 341, RG 330. In FY 1952, according to the RDB report, the Air Force contracted 80 percent of its R&D funds to industry and nonprofit organizations,

the Navy 68 percent, and the Army 43 percent.
47. In FY 1952, the Air Force obligated about two-thirds of its R&D funds ($292 million of $445 million) to industrial contractors. See Research and Development Board, "Budget and Fiscal Information on Research and Development Program, FY 1952–FY 1954" (RDB 106/25), 25 September 1952, 17, folder RDB 106.7, Fiscal Year 1954, box 497, entry 341, RG 330.
48. G. R. Simonson, "Missiles and Creative Destruction in the American Aircraft Industry, 1956–1961," in *The History of the American Aircraft Industry: An Anthology*, ed. G. R. Simonson, 231.
49. Mundy I. Peale, "Aircraft Production Problems," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 25 February 1948, 18, NDU Library.
50. Bright, *Jet Makers*, 115.
51. Ibid.; Clarence L. Johnson and Maggie Smith, *Kelly: More Than My Share of It All*; and Ben R. Rich and Leo Janos, *Skunk Works: A Personal Memoir of My Years at Lockheed*.
52. Philip Shiman, *Forging the Sword: Defense Production During the Cold War*, USACERL Special Report 97/77 (United States Air Force Air Combat Command and Department of Defense Legacy Program, Cold War Project, July 1997), 57; Bright, *Jet Makers*, 123; and Anthony DiFilippo, *Military Spending and Industrial Decline: A Study of the American Machine Tool Industry*, 56-58. For an excellent analysis of the impact of automatically controlled machine tools on society, particularly on labor, see David F. Noble, *Forces of Production: A Social History of Industrial Automation*, and his article "Command Performance: A Perspective on Military Enterprise and Technological Change," in *Military Enterprise and Technological Change: Perspectives on the American Experience*, ed. Merritt Roe Smith, 329-46.
53. George W. Motherwell, "Heavy Presses Now in Production," *Mechanical Engineering* 78, no. 3 (March 1956): 216.
54. Bright, *Jet Makers*, 122.
55. Ibid., 123-25.
56. Table 1 (U.S. Aircraft Production, Calendar Years, 1909–1974), in app. to Bilstein, *Enterprise of Flight*, 226-27.
57. Bright, *Jet Makers*, 125.
58. Edward H. Heinemann, "Problems in Aircraft Production," 11 February 1953, 7.
59. Simonson, "Creative Destruction," 231.
60. Murphy, "Anxious Aircraft 'Primes'," 278; Simonson, "Creative Destruction," 231; and Pattillo, *Pushing the Envelope*, 205. In the 1950s, the non-airframe competitors for missile contracts included AC Sparkplug, Aerojet General, American Bosch Arma, American Machine and Foundry, Avco Manufacturing, Bell Telephone Laboratories, Bendix, Burroughs, Chrysler, General Electric, Goodyear, Honeywell, Philco (Philco-Ford after 1961), Raytheon, Remington Rand, Sperry (Sperry Rand after 1955), and Western Electric.
61. Simonson, "Demand for Aircraft," 381.
62. Simonson, "Creative Destruction," 239-40.
63. Lt. Gen. Ira C. Eaker, "The Army Air Forces, Its Status, Plans, and Policies," address to the National War College, 5 June 1947, 10, unlabeled folder, box 4, entry 3, RG 340.
64. Donald J. Mrozek, "The Truman Administration and the Enlistment of the Aviation Industry in Postwar Defense," *Business History Review* 48, no. 1 (Spring 1974): 73-94.
65. Kofsky, *War Scare of 1948*, 1-82 (quotation from Air Coordinating Committee letter of 17 June 1947, p. 60), 169-213. The Air Coordinating Committee included representatives from the Commerce, Navy, State, and War Departments (the new Department of the Air Force replacing the latter on the committee in September 1947), the Post Office, and the Civil Aeronautics Administration. Each member was an assistant secretary or equivalent rank.
66. Quoted in Kofsky, *War Scare of 1948*, 64.
67. Ibid., 62-65.
68. Ltr, W. Stuart Symington to Thomas K. Finletter, 28 October 1947, folder Secretary of the Air Force (2), box 264, Papers of Gen. Carl Spaatz, U.S. Air Force, LC.

69. Memo, Brig. Gen. D. F. Stace, Chief, Procurement and Industrial Planning Division, Office, Assistant Chief of the Air Staff-4, for General Powers [Maj. Gen. E. M. Powers], Assistant Chief of the Air Staff-4, 25 August 1947, sub: Breakdown of Expenditure of 1948 Funds, folder JCS Merger, box 51, Vandenberg Papers, LC.
70. Minutes, USAF Aircraft and Weapons Board meeting, 20 August 1947, 195-96, folder Verbatim Minutes, First Meeting, USAF Aircraft and Weapons Board, Second Day, 20 August 1947, box 181, entry 190 (Deputy Chief of Staff, Development; Director of Requirements; Executive Office; Mail and Records Branch; First Aircraft and Weapons Board; Subject File, 1947–1948), RG 341. The full names and positions of the officers cited in the transcript in the order of their appearance are: Lt. Gen. Hoyt S. Vandenberg, deputy commanding general, AAF; Maj. Gen. Edward M. Powers, assistant chief of the Air Staff for materiel; Maj. Gen. Curtis E. LeMay, deputy chief of Air Staff for research and development; Maj. Gen. Paul L. Williams, commanding general, Tactical Air Command; and Maj. Gen. Edwin L. Rawlings, AAF comptroller.
71. Ibid., 196.
72. Ltr, Gen. Joseph T. McNarney, Commanding General, Air Materiel Command, to the Chief of Staff, 16 February 1948, sub: Procurement of F–12 Aircraft, no folder, box 62, entry 380, RG 341.
73. Summary Minutes of the First Meeting of the USAF Aircraft and Weapons Board, 10, encl. to memo, Col. Leslie O. Peterson, Acting Secretary, USAF Aircraft and Weapons Board, for Commanding General, Army Air Forces, sub: Summary Minutes of First Meeting, USAF Aircraft and Weapons Board, 12 September 1947, folder Summary Minutes of First Meeting of the USAF Aircraft and Weapons Board, 19–22 Aug 47, box 181, entry 190, RG 341.
74. Kofsky, *War Scare of 1948*, 79-80. Although the board's recommendations would not be made public until approved by the chief of staff and secretary of the Air Force, it is likely that the results of its deliberations had been leaked to Douglas and other aircraft manufacturers. At the Aircraft and Weapons Board's next full meeting in January 1948, General Vandenberg cautioned all those present to keep the board's work confidential: ". . . the repercussions from the last meeting with the manufacturers were very undesirable. . . . It makes a great deal of difference in the ability to negotiate the Materiel Command will have, as to whether or not people leave this meeting and go out and talk to manufacturers, or if manufacturers know what goes on in this room." See minutes, USAF Aircraft and Weapons Board meeting, 27 January 1948, 3, folder Verbatim Minutes, Second Meeting, USAF Aircraft and Weapons Board, First Day, 27 January 1948, box 183, entry 190, RG 341.
75. Memo, Lt. Gen. Hoyt S. Vandenberg for Mr. Symington, 5 September 1947, folder Office of the Secretary of the Air Force, box 58, Vandenberg Papers, LC.
76. Ibid.
77. Kofsky, *War Scare of 1948*, 12.
78. Memo, Col. Leslie O. Peterson, Acting Secretary, USAF Aircraft and Weapons Board, for Commanding General, Army Air Forces, 25 August 1947, sub: Fiscal Year 1948 Aircraft Procurement Program, folder First Meeting, Misc. Correspondence, box 181, entry 190, RG 341.
79. Kofsky, *War Scare of 1948*, 12-13, 20-21, 189. The AAF had acquired Constellations during World War II, designating them the C–69. The reconfigured Constellation would be designated the C–121.
80. 1st indorsement, Gen. Carl Spaatz to Chairman, USAF Aircraft and Weapons Board, 7 October 1947, to memo, Peterson for Commanding General, Army Air Forces, 12 September 1947.
81. Ibid.
82. Summary Minutes of the Second Meeting of the USAF Aircraft and Weapons Board, 5, 9-10, atch to memo, Brig. Gen. F. H. Smith, Jr., Secretary, USAF Aircraft and Weapons Board, for the Chief of Staff, 10 February 1948, folder Summary Minutes of Second Meeting, USAF

Aircraft and Weapons Board, 27-30 January 1948, box 183, entry 190, RG 341; and ltr, Robert E. Gross to Gen. J. T. McNarney, 11 May 1949, folder Aircraft-Airline Industry, 1948–1950, box 3, Fairchild Papers, LC.

83. Minutes, USAF Aircraft and Weapons Board meeting, 28 January 1948, 262-63, folder Verbatim Minutes, Second Meeting, USAF Aircraft and Weapons Board, Second Day, 28 January 1948, box 183, entry 190, RG 341.

84. Ibid., 234-63; minutes, USAF Aircraft and Weapons Board meeting, 29 January 1948, 360-61, 379-87, folder Verbatim Minutes, Second Meeting, USAF Aircraft and Weapons Board, Third Day, 29 January 1948 (quotation, 383); and Summary Minutes of the Second Meeting of the USAF Aircraft and Weapons Board, 5, 9-11, atch to memo, Smith for the Chief of Staff, 10 February 1948: all in box 183, entry 190, RG 341. The key redesign feature of the modified C–74 (eventually designated the C–124 Globemaster II) that made it more acceptable to the Air Force was the addition of a loading ramp. In the version of the C–74 considered by the Aircraft and Weapons Board in August, mechanical lifts loaded equipment into the airplane.

85. *Report of the Secretary of the Air Force to the Secretary of Defense for Fiscal Year 1948*, 289.

86. In addition to the $10 to $12 million requested by Gross for reconfigured Constellations, the Air Force planned to spend $13 million on four C–74 prototypes. See Summary Minutes of the Second Meeting of the USAF Aircraft and Weapons Board, 9, atch to memo, Smith for the Chief of Staff, 10 February 1948.

87. Simonson, "Demand for Aircraft," 378; and Robert Frank Futrell, *Ideas, Concepts, and Doctrine: Basic Thinking in the United States Air Force*, Vol. I, *1907–1960*, 216-17.

88. Summary Minutes of the First Meeting of the USAF Aircraft and Weapons Board, 10, atch to memo, Peterson for Commanding General, Army Air Forces, 12 September 1947. The Navy's FY 1948 appropriation for new aircraft procurement was $322 million. See table (Appropriations for Military Aviation for Purchase of New Aircraft, 1922–1948), atch to memo, Halford C. Davis [fall 1947], box 14, entry 23 (Office of the Administrative Assistant; Correspondence Control Division; General File by Organization and Subject, 1947–Jan. 1953; Assistant Secretary of the Air Force, Materiel, Jun. 1951–Oct. 1951, R. L. Gilpatric, Official Reading File, Jun. 1951–Aug. 1951), RG 340.

89. Memo, A. S. Barrows for Mr. Symington, 3 May 1948, atch to memo, W. Stuart Symington for Mr. Forrestal, 8 May 1948, folder OSD Chronological File (Symington to Forrestal), box 6, entry 3, RG 340.

90. Memorandum for the Press, Air Information Division, Department of the Air Force, 29 May 1948, folder Air Proving Ground Command, 1948, box 3, Fairchild Papers, LC.

91. See table (Supplemental 1948 Procurement Program), 12 November 1948, folder Research and Development, 1948–1949, 1950, box 4, Fairchild Papers, LC; and memo, G. B. Woods, Special Assistant to the Secretary of the Air Force, 16 June 1949, sub: Airframe Contractor's Military Backlogs, 31 March 1949, folder 452.1, 1948–1949, box 9, entry 377A (Office of the Deputy Chief of Staff, Materiel; Executive Office; Administrative Branch; General Decimal File, 1948–1952), RG 341.

92. Futrell, *Ideas, Concepts, and Doctrine*, Vol. I, 240-45, 250; and George M. Watson, Jr., *The Office of the Secretary of the Air Force, 1947–1965*, 87-88. Funds appropriated in FY 1950 allowed the Air Force to buy only approximately 1,250 new aircraft.

93. Table 1 (U.S. Aircraft Production, Calendar Years, 1909–1974), in app. to Bilstein, *Enterprise of Flight*, 226-27.

94. Table 12 (Aircraft Production, 1946–1960), in Rae, *Climb to Greatness*, 202.

95. Pattillo, *Pushing the Envelope*, 155.

96. *Report of the Secretary of the Air Force to the Secretary of Defense for Fiscal Year 1948*, 289 [italics in original].

97. Table 1 (U.S. Aircraft Production, Calendar Years, 1909–1974), in app. to Bilstein, *Enterprise of Flight*, 226-27.

98. Memo, Gen. Omar N. Bradley, Chairman, Joint Chiefs of Staff, for Secretary of Defense,

25 March 1952, sub: Revision of Department of Defense Master Urgency List, with encl. "Department of Defense Master Urgency List," folder CD 470.14 (Mil. Urgency) 1 Mar.–20 May 1952, box 379, entry 199 (Confidential through Top Secret Subject Correspondence File, 1947–1953), RG 330.

99. Assistant Secretary of Defense (Supply and Logistics), *Munitions Production Report*, 21 August 1953, table (B and RB–47 Bomber), 21, folder Munitions Production Reports, box 87, entry 220 (Historical Manuscripts and Papers Containing Background Data Re: Munitions Board and Industrial Mobilization Programs, 1947–1953), RG 330; and Marcelle Size Knaack, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems*, Vol. II, *Post–World War II Bombers, 1945–1973*, 155. Of the 2,041 B–47s that had entered the inventory by July 1953, 293 were reconnaissance or other variants of the bomber.

100. For my discussion of concurrency in the B–47 program, I am indebted to the analysis of Michael E. Brown, *Flying Blind: The Politics of the U.S. Strategic Bomber Program*, esp. 97-103.

101. See chap. 5; and Brown, *Flying Blind*, 68-69, 78-80, 96-97, 105-07.

102. Knaack, *Post–World War II Bombers*, 101-06. On 10 July 1947, after two-and-a-half years of negotiation, the original letter contract was definitized as a fixed-price contract. See Margaret C. Bagwell, *The XB–47 and B–47 Aircraft*, Vol. I, 3-4, microfilm roll 25959, AFHSO.

103. Ibid., 107-08. Before the end of 1949, the Air Force ordered 46 more B–47Bs and reduced B–47A procurement from 13 to 10, for a total of 97 aircraft.

104. Ibid., 110; Brown, *Flying Blind*, 96-97, 100; and Jan Tegler, *B–47 Stratojet: Boeing's Brilliant Bomber*, 18, 33, 35.

105. Knaack, *Post–World War II Bombers*, 108.

106. With respect to the question of strategic vulnerability, see memo, Gen. Hoyt S. Vandenberg for Mr. Symington, 22 August 1949, sub: Military Advantages of Location of B–47 Assembly Plant at Wichita vs. Seattle, encl. to memo, Brig. Gen. Alfred A. Kessler, Jr., Director, Procurement and Industrial Planning, Office, Deputy Chief of Staff, Materiel, for Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel, Headquarters, U.S. Air Force, 10 October 1949, sub: Data Compiled for the Secretary of the Air Force to Support the Air Force's Position Regarding Production of the B–47 at Wichita, folder 452.1, B–47, 1949–1951, box 53, entry 377A, RG 341.

107. Memo, Lt. Gen. H. A. Craig, Deputy Chief of Staff, Materiel, for Mr. W. Stuart Symington, 15 August 1949, sub: Boeing Airplane Company, Seattle, Washington, folder 160, Boeing, box 2, ibid.

108. "Boeing's Bombers," *Fortune* 44 (September 1951): 98; Tegler, *B–47 Stratojet*, 21-22; and Boeing Airplane Company, *The B–47 Stratojet in Retrospect*, pamphlet ca. 1957, copy in folder Boeing, box 114, LeMay Papers, LC.

109. Quoted in Eugene Rodgers, *Flying High: The Story of Boeing and the Rise of the Jetliner Industry*, 107.

110. Ltr, William M. Allen, President, Boeing Airplane Company, to Hon. W. Stuart Symington, Secretary of the Air Force, 18 May 1949, in Bagwell, *XB–47 and B–47 Aircraft*, Vol. III, doc. 224, microfilm roll 14586, AFHSO. For Symington's reply, see ltr, W. Stuart Symington to William M. Allen, 14 June 1949, folder Certification of Aircraft Procurement Contracts, box 37, entry 3, RG 340.

111. Ltr, William M. Allen, President, Boeing Airplane Company, to Hon. W. Stuart Symington, Secretary of the Air Force, 17 June 1949, folder Certification of Aircraft Procurement Contracts, box 37, entry 3, RG 340.

112. Memo for Secretary Symington, sub: Notes with Reference to Boeing Airplane Company, Seattle, Washington, and Wichita, Kansas, encl. to memo, Kessler for Wolfe, 10 October 1949.

113. Rodgers, *Flying High*, 107; ltr, A. J. Hayes, International President, International Association of Machinists, to The Honorable W. Stuart Symington, 4 August 1949, and ltr, Symington to Hayes, 19 August 1949: both in folder 160, Boeing, box 2, entry 377A, RG 341; and ltr, W. Stuart Symington to Hon. Hugh B. Mitchell, 31 August 1949, encl. to memo,

Kessler for Wolfe, 10 October 1949.
114. Rodgers, *Flying High*, 108.
115. Knaack, *Post–World War II Bombers*, 109.
116. By the early 1950s, the term "wing" had replaced "group" as the designation of the Air Force's primary combat organization.
117. See chap. 5; and Walton S. Moody, *Building a Strategic Force*, 391. A year later, the Air Force was authorized to expand to 143 wings, including 30 medium strategic bombardment wings and 6 medium strategic reconnaissance wings.
118. Table (B–47 Procurement Programs), atch to memo, Foster Adams, Director, Progress Reports and Statistics, Office of the Secretary of Defense, for Secretary Wilson [Secretary of Defense Charles E. Wilson], 19 June 1953, folder CD 400.12, 1953, box 38, entry 199, RG 330.
119. Memo, Gen. Hoyt S. Vandenberg, for Mr. McCone, 8 December 1950, sub: B–47 Operational Readiness, folder Vandenberg Files 1950, box 33, Vandenberg Papers, LC. The memo defined operational readiness as "the date one group [wing], adequately supported and manned, can accomplish missions as outlined in the current war plan with acceptable results."
120. Table (B–47 Production, Actual and Scheduled), atch to memo, Adams for Wilson, 19 June 1953. The B–47B first flew on 26 April 1951. See Tegler, *B–47 Stratojet*, 41.
121. Memo, John A. McCone for the Chief of Staff, 21 September 1950, and ltr, Wellwood E. Beall, Vice President, Engineering and Sales, Boeing Airplane Company, to Secretary of the Air Force Thomas K. Finletter, 14 September 1950: both in folder Vandenberg Files 1950, box 33, Vandenberg Papers, LC.
122. Harry S. Truman, "Annual Message to the Congress on the State of the Union," 8 January 1951, *Public Papers of the Presidents of the United States: Harry S. Truman, 1951*, 11. It is likely that the president was imitating Franklin Roosevelt's call, in the spring of 1940 as German armies were overrunning France and the Low Countries, for the United States to produce 50,000 planes.
123. Futrell, *Ideas, Concepts, and Doctrine*, Vol. I, 318.
124. Memo, John A. McCone, Under Secretary of the Air Force, for Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel, Headquarters, U.S. Air Force, 8 December 1950, folder Assistant Secretary of the Air Force, box 37, Vandenberg Papers, LC.
125. Knaack, *Post–World War II Bombers*, 112 (note 10); and Tegler, *B–47 Stratojet*, 49. The Air Force concluded a variety of production contracts for the B–47, seven by mid-1953. The initial production contract, a cost-plus-fixed-fee letter contract with Boeing on 22 November 1948, was definitized on 14 November 1949. Boeing subsequently received three fixed-price incentive contracts. On 27 December 1950, Douglas received a cost-plus-fixed-fee letter contract as did Lockheed on 26 March 1951. Lockheed subsequently received a second contract (cost-plus-incentive fee). See Bagwell, *XB–47 and B–47 Aircraft*, Vol. I, 5-7; Margaret C. Bagwell, *History of the B–47 Production Program, 1949–1953*, Vol. I, 70-71, microfilm roll 25960, AFHSO; and "B–47 Program," n.d., and memo, F. I. Robertson, Executive for Finance, Directorate of Procurement and Production, Office of the Deputy Chief of Staff, Materiel, for Major General Baker, 7 June 1954, sub: Evaluation of Three Types of Contracts for B–47 Production: both in R. Mason Kipp, *History of B–47 Procurement, Production, and Modification, 1953–1956*, Vol. III, microfilm roll 14590, AFHSO.
126. Boeing, *Stratojet in Retrospect*, 33.
127. Ltr, William M. Allen, President, Boeing Airplane Company, to Hon. John A. McCone, Under Secretary of the Air Force, 5 February 1951, enclosing telegram, Frederick E. Hines, Douglas Aircraft Co., Inc., to James E. Prince, Boeing Airplane Company, 25 January 1951; and telegram, Prince to Hines, 25 January 1951: all in folder 160, Boeing Aircraft, box 37, entry 377A, RG 341. Allen stated to McCone that Maj. Gen. Orval Cook, the Air Materiel Command's director of procurement and industrial planning, had let it be known that he considered agreements regarding technical assistance furnished by one company to another to be an internal industry matter.

128. Ltr, Allen to McCone, 5 February 1951, ibid.
129. John A. McCone, Memorandum of Discussion with Mr. Donald Douglas and Mr. Conant of Douglas Aircraft Corporation, 29 January 1951, folder 452.1, B–47, 1949–1951, box 53, entry 377A, RG 341.
130. John A. McCone, memorandum for file, 7 February 1951, folder 452.1, Aircraft, box 44, entry 377A, RG 341. J. H. Kindelberger, president of North American Aviation, and Oliver P. Echols, chairman of the board and general manager of Northrop, also attended the meeting. North American, at one time a candidate to manufacture the B–47, had also signed a technical assistance agreement with Boeing.
131. Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel, Headquarters, U.S. Air Force, "Policy on Costs and Fees Involved in Production of Aircraft and Equipment by Original Manufacturers and Second Producers," 14 February 1951, ibid. See also ltr, W. E. Beall, Vice President, Engineering and Sales, Boeing Airplane Company, to Commanding General, Air Materiel Command (Attn: Brig. Gen. Phillips W. Smith, Chief, Procurement Division), 30 March 1951, sub: B–47 Joint Production Program [summarizes Boeing's understanding of the terms of agreement with the Air Force regarding compensation for technical assistance], in Bagwell, *B–47 Production Program, 1949–1953*, Vol. III, microfilm roll 14589, AFHSO.
132. Rpt, Col. Dennis Mulligan, Executive Officer, Division of Procurement and Production, Air Materiel Command, to General Bradley [Maj. Gen. Mark E. Bradley, director of procurement and industrial planning, AMC], 15 October 1951, sub: B–47 Production Committee and B–47 Field Project Office, in Bagwell, *B–47 Production Program*, Vol. III.
133. Ibid., 1, 6, 10.
134. Ibid., 7-8; ltr, Maj. Gen. Orval R. Cook, Director, Procurement and Industrial Planning, Air Materiel Command, to Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel, Headquarters, U.S. Air Force, 3 April 1951, and ltr, Wolfe to Cook, 18 April 1951: both in folder Air Materiel Command, 1951, box 41, entry 377A, RG 341.
135. Douglas built 364 and Lockheed 394 of the total of 2,041 B–47s manufactured. See Knaack, *Post–World War II Bombers*, 124, 142.
136. Table (B–47 Production, Actual and Scheduled), atch to memo, Adams for Wilson, 19 June 1953.
137. Knaack, *Post–World War II Bombers*, 120-22.
138. Memo, John A. McCone for the Deputy Chief of Staff, Materiel, 14 March 1951, folder 452.1, B–47, 1949–1951, box 53, entry 377A, RG 341.
139. Ibid.
140. Ltr, J. E. Schaefer, Vice President and General Manager, Wichita Division, Boeing Airplane Company, to Gen. Hoyt S. Vandenberg, 10 September 1951, folder B (General), box 17, Vandenberg Papers, LC.
141. Ltr, Lt. Col. Reade Tilley, Deputy Director, Office of Public Information, Strategic Air Command, to Maj. Gen. Clarence S. Irvine, 3 December 1951, folder Irvine, box 53, LeMay Papers, LC.
142. Kipp, *B–47 Procurement, Production, and Modification, 1953–1956*, Vol. I, 20, microfilm roll 23716, AFHSO; and Knaack, *Post–World War II Bombers*, 120-21.
143. See esp. Brown, *Flying Blind*, 97-98, but also Knaack, *Post–World War II Bombers*, 112, 114 (note 13).
144. Knaack, *Post–World War II Bombers*, 117. In-flight maintenance was not possible because some K–2 components were located outside the aircraft's pressurized area.
145. Memo, R. L. Gilpatric, Assistant Secretary of the Air Force, for Mr. McCone, 15 June 1951, sub: Conference at AMC on June 14, 1951, to Discuss B–36 and B–47 Problems, folder Official Reading File, entry 23, RG 340.
146. Knaack, *Post–World War II Bombers*, 117; and Brown, *Flying Blind*, 98.
147. Bagwell, *B–47 Production Program*, Vol. I, 41-46, microfilm roll 25960, AFHSO; Knaack, *Post–World War II Bombers*, 117; and Brown, *Flying Blind*, 97-98.

148. Memo, Gilpatric for McCone, 15 June 1951.
149. Bagwell, *B–47 Production Program*, Vol. I, 41-46; Knaack, *Post–World War II Bombers*, 117; and Brown, *Flying Blind*, 97-98.
150. Bagwell, *B–47 Production Program*, Vol. I, 19-47; Knaack, *Post–World War II Bombers*, 116-18; and Brown, *Flying Blind*, 97-98.
151. Bagwell, *B–47 Production Program*, Vol. I, 46. In September 1951, two B–47Bs collided in mid-air; the accident occurred when one of the aircraft approached the other to check a reported landing-gear malfunction. See Semi-Annual Historical Report, 1 July 1951 through 31 December 1951, 1, in Bagwell, *B–47 Production Program*, Vol. III.
152. Bagwell, *B–47 Production Program*, Vol. I, 25-26; and Knaack, *Post–World War II Bombers*, 118.
153. John A. McCone, notes on the Boeing Wichita Plant, 22 September 1951, encl. to note, Col. R. H. Marshall, Military Executive to the Under Secretary of the Air Force, for General Twining [General Nathan F. Twining, vice chief of staff], 2 October 1951, folder 452.1, B–47, 1949–1951, box 53, entry 377A, RG 341; memo, Col. Cordes F. Tiemann, Executive to the Inspector General, for General Boatner [Maj. Gen. Bryant L. Boatner, the inspector general], 6 August 1952, sub: AMC–B47 Task Force, folder Miscellaneous Actions and Policy Papers, box 119, Twining Papers, LC; ltr, Lt. Gen. Orval R. Cook, Deputy Chief of Staff, Materiel, to Commanding General, Air Materiel Command, and Commanding General, Air Research and Development Command, 15 August 1952, sub: Correction of Deficiencies, B–47 Aircraft, folder 452.1, B–47, 1952, box 53, entry 377A, RG 341; memo, Col. Wayne E. Thurman, Secretary of the Air Staff, for General Twining, General McKee [Maj. Gen. William F. McKee, assistant vice chief of staff], folder Aircraft, 5, box 34, Vandenberg Papers, LC; and Bagwell, *B–47 Production Program*, Vol. I, 26.
154. Ltr, Lt. Gen. Orval R. Cook, Deputy Chief of Staff, Materiel, to William L. Allen, President, Boeing Airplane Company, 29 August 1952, folder 452.1, B–47, 1952, box 53, entry 377A, RG 341.
155. Ltr, Allen to Cook, 10 September 1952, ibid.
156. Ltr, Cook to Allen, 17 September 1952, ibid.
157. Ltr, Allen to Cook, 26 September 1952, ibid.
158. Ltr, Vandenberg to Allen, 2 October 1952, ibid.
159. "Notes on General Vandenberg's Letter of October 2, 1952," encl. to ltr, Allen to Vandenberg, 27 October 1952, ibid.
160. Ltr, Vandenberg to Allen, 5 December 1952, ibid.
161. For the modification program, see Bagwell, *B–47 Production Program*, Vol. I, 53-58; Knaack, *Post–World War II Bombers*, 119-20; and Brown, *Flying Blind*, 99 (note 70).
162. When the modification program exceeded Grand Central Aircraft's capabilities, the Air Force also concluded contracts with Boeing and Douglas to assist in the effort.
163. Of the 399 B–47Bs manufactured, only 310 were modified; the remainder went to the Air Training Command and were not intended for tactical employment. See Knaack, *Post–World War II Bombers*, 119-20.
164. The B–47E was the main production version of the Stratojet. Of the 1,341 B–47Es manufactured, Boeing built 691; Douglas, 264; and Lockheed, 386. The last B–47E was delivered to the Air Force in February 1957. See ibid., 133, 142-43.
165. Ibid., 120; and Kipp, *B–47 Procurement, Production, and Modification, 1953–1956*, 8.
166. Maj. Gen. Clarence S. Irvine, deputy commander for production at the Air Materiel Command, drafted Vandenberg's letter to Allen of 2 October 1952. Irvine had spent much of his career in acquisition-related assignments. He was also close to LeMay, having commanded SAC's 509th Strategic Bomb Wing (the first unit capable of delivering atomic bombs), the first B–36 wing, the 19th Air Division, and just prior to taking up the post at the Air Materiel Command, the 8th Air Force. In November 1952, he described the letter's apparent impact to Vandenberg: "I have been informed that the letter, when received by Boeing, had quite a

salutary effect. It has certainly been of great assistance to AMC in our endeavors to make the company step up to their responsibilities for production of a complete tactical weapon." See ltr, Irvine to Vandenberg, 5 November 1952, encl. to ltr, Irvine to Lt. Gen. Orval R. Cook, Deputy Chief of Staff, Materiel, 6 November 1952, folder 400.112, Projects, 1952, box 52, entry 377A, RG 341.

167. "ARDC: An Integration of Effort," 2, ca. 1953, folder Air Research and Development Command, box 16, entry 10, RG 341.

168. See W. D. Putnam, *The Evolution of Air Force System Acquisition Management*, R-868-PR, 6; and Knaack, *Post–World War II Bombers*, 100, 112.

169. Brown, *Flying Blind*, 99-103 (quotation, 102).

170. Ltr, Wellwood E. Beall, Vice President, Engineering and Sales, Boeing Airplane Company, to Secretary of the Air Force Thomas K. Finletter, 14 September 1950, folder Vandenberg Files 1950, box 33, Vandenberg Papers, LC.

171. "Brigadier General Guy M. Townsend," U.S. Air Force Official Website, Biographies Database, http://www.af.mil/information/bios/bio.asp?bioID=7417 (retrieved 22 July 2011); Rodgers, *Flying High*, 103; Robert J. Serling, *Legend and Legacy: The Story of Boeing and Its People*, 88, 93-97, 107; and Tegler, *B–47 Stratojet*, 15-18.

172. Senate, Statement by Sen. Paul H. Douglas (D-Ill.), "Certain Retired Military Officers Employed by Corporations with Defense Contracts," 86th Cong., 1st sess., *Congressional Record* (17 June 1959), 105, pt. 8: 11040-45. The following is a listing of some of the Air Force general officers who worked for defense contractors between 1945 and 1959 who also held key acquisition assignments during their careers. In addition to identifying the assignment, the list indicates the company (or companies) for which the officer worked following retirement: Maj. Gen. F. L. Ankenbrandt, director of communications, Office, Deputy Chief of Staff, Operations, 1947–1950 (Radio Corporation of America); Maj. Gen. Albert Boyd, deputy commander for systems, Air Research and Development Command, 1955–1957 (Westinghouse Electric); Maj. Gen. Merrill D. Burnside, director, maintenance and engineering, Air Materiel Command, 1954–1956 (Philco); Brig. Gen. Oscar F. Carlson, assistant deputy chief of staff, materiel, 1951–1953 (Douglas); General Benjamin W. Chidlaw, commanding general, Air Materiel Command, 1949–1951 (TRW); Lt. Gen. Orval R. Cook, deputy chief of staff, materiel, 1951–1954 (president, Aircraft Industries Association); Maj. Gen. Alden R. Crawford, director of materiel, European Command, 1952 (Republic); Maj. Gen. Frederic R. Dent, Jr., commander, Mobile, Ala. Air Materiel Area, Air Materiel Command, 1953–1957 (Martin); Lt. Gen. James H. Doolittle, special assistant to the chief of staff, 1951–1953 (Shell Oil, TRW); Lt. Gen. Ira C. Eaker, deputy commanding general, AAF, 1945–1947 (Hughes Tool Co., Douglas); Maj. Gen. Oliver P. Echols, assistant chief of Air Staff, materiel and services, 1944–1945 (president, Aircraft Industries Association, Northrop); Lt. Gen. Harold L. George, commanding general, Air Transport Command, 1942–1945 (Hughes Aircraft, TRW); Lt. Gen. Clarence S. Irvine, deputy chief of staff, materiel, 1955–1959 (Avco); Brig. Gen. Harley S. Jones, deputy for production, Directorate of Procurement and Production, Air Materiel Command, 1953–1957 (Republic); Lt. Gen. William E. Kepner, commander, Air Proving Ground Command (Bell Aircraft); General Joseph T. McNarney, commanding general, Air Materiel Command, 1947–1949 (Convair); Brig. Gen. Leland W. Miller (Convair); Maj. Gen. E. M. Powers, assistant chief of Air Staff, materiel and services, 1945–1949 (Curtiss-Wright); Lt. Gen. Donald L. Putt, commander, Air Research and Development Command, 1953–1954 (United Aircraft, System Development Corporation); Maj. Gen. W. L Richardson, commander, Air Force Missile Test Center, 1950–1954 (RCA); Brig. Gen. Horace A. Shepard, assistant deputy chief of staff, procurement and production engineering, Office, Deputy Chief of Staff, Materiel, 1950–1951 (TRW); Brig. Gen. Turner A. Sims, Jr., deputy chief of staff, AAF Materiel Command, 1944 (United Aircraft); Maj. Gen. K. E. Tibbetts, comptroller, Air Materiel Command, 1952–1956 (Martin); Lt. Gen. Patrick W. Timberlake, commander, Air Proving Ground Command, 1952–1955 (Northrop); Maj. Gen. John M. Weikert, assistant deputy commanding general for

materiel, Air Materiel Command, 1946–1947 (United Aircraft); Brig. Gen. William W. Welsh (Fairchild); Lt. Gen. Kenneth B. Wolfe, deputy chief of staff, materiel, 1949–1951 (Oerlikon Tool and Arms Corporation of America, Garrett Corporation). Not all of the officers listed above appear in the document inserted in the *Congressional Record* because some had left their position in industry before 1959. Official biographies of active and retired Air Force general officers are available on the U.S. Air Force's website, http://www.af.mil/information/bios/. Only a few biographies of officers retiring before 1947 are included on the website listing.

173. William Proxmire, "Retired High-Ranking Military Officers," in Carroll W. Pursell, Jr., *The Military-Industrial Complex*, 254.

174. Fox and Field, *Defense Management Challenge*, 234.

175. Alex Roland, *The Military-Industrial Complex*, 27-28.

176. For a discussion of the revolving door from this perspective, see Fox and Field, *Defense Management Challenge*, 233-39.

177. For an early assessment of the significance for American society of the employment of retired military officers by corporations engaged in defense work, see C. Wright Mills, *The Power Elite*, 211-16.

178. Jonathan Foster Fanton, "Robert A. Lovett: The War Years," Ph.D. diss., Yale University, 1978, 86-91.

179. Donald L. Barlett and James B. Steele, *Empire: The Life, Legend, and Madness of Howard Hughes*, 171-72.

180. Memo, Maj. Gen. E. M. Powers, Acting Deputy Chief of Staff, Materiel, for the Under Secretary of the Air Force [Arthur S. Barrows], 31 July 1948, no folder, box 60, entry 380, RG 341. See also Pattillo, *Pushing the Envelope*, 166-67.

181. Pattillo, *Pushing the Envelope*, 183.

182. Beech Aircraft Corporation Charges Against USAF, March 1949, 3, folder 160, Aircraft Companies, A-Z, 1949, box 2, entry 377A, RG 341. This document is an internal Air Force summary of the charges made by Gaty in a letter of 29 March 1949 and in a telephone call to Secretary of the Air Force Symington on 31 March 1949.

183. Ibid., 198. At the Aircraft Industries Association meeting in Williamsburg in May 1948, Symington told the assembled aircraft manufacturers: ". . . it is recommended that when any aircraft company, or aircraft accessory corporation, employs any former member of the military establishment, such employment be handled on the condition that said former member does not act as a sales representative; in other words, he not be put in a position where he is attempting to sell or negotiate with his former friends in the Air Force. The dangers here from the standpoint of possible government or/and public reaction are only too obvious." See "Remarks by W. Stuart Symington," Annual Meeting of the Board of Directors, Aircraft Industries Association, Williamsburg, Va., 19 May 1948, 1, folder Secretary of the Air Force (2), box 59, Vandenberg Papers, LC. At that time, the law (18 U.S.C. 202, Section 112, Criminal Code, and 18 U.S.C. 203, Section 113, Criminal Code) prohibited retired officers "from procuring or aiding to procure Government contracts for another" or "from representing another in the sale of anything to the Department of the Air Force." In interpreting the meaning of the law, Air Force Regulation (AFR) 30-30, 18 June 1948, stated that the "spirit of the statutes" includes "any activity by a retired officer on behalf of a prospective contractor which reasonably and directly is aimed toward forming the basis for a contract with the Government. On the other hand, it is not the intent of these statutes to preclude a retired officer from accepting employment in private industry solely because his employer is a contractor with the Government. Therefore, these statutes should not be construed as applicable to activities which are only remotely connected with claims or contractual matters as distinguished from direct participation in obtaining a contract with the Government on behalf of a prospective contractor." A copy of AFR 30-30, 18 June 1948, is in folder AF Reg. 30-30, 1949–1951, box 90, entry 481 (Deputy Chief of Staff, Materiel; Director of Procurement and Production; Procurement Policy Division; Subject File, 1948–1952), RG 341.

184. Memo, Maj. Gen. Francis H. Griswold, Assistant Deputy Chief of Staff, Materiel, for General McKee, 29 July 1949, sub: Training Aircraft and Changes to All Aircraft, encl. to memo, Maj. Gen. William F. McKee, Assistant Vice Chief of Staff, for the Deputy Chief of Staff, Materiel, 5 August 1949, folder General Correspondence, June–July 1949, box 1, Fairchild Papers, LC. Ironically, although Beech's prototype came out on top, the Air Force did not give the company a production contract, opting instead to reopen T–6 production. See memo, Maj. Gen. Carl A. Brandt, Assistant Deputy Chief of Staff, Materiel, for General Twining, 24 January 1951, sub: Comparison of T–6 and T–34 Aircraft, folder Aircraft, 4, Vandenberg Papers, LC.
185. My account of these events is based on Watson, *Secretary of the Air Force*, 88-97; and Murray Green, "Stuart Symington and the B–36 Controversy," Ph.D. diss., The American University, 1960, esp. 158-210.
186. Another of the allegations was that Emerson Electric, a company that Symington had headed before entering government service in 1945, was profiting unethically from contracts for the manufacture of B–29 gun turrets.
187. Information contained in the document had been provided by representatives of the Glenn L. Martin Company, whose medium-range XB–48 had lost out to Boeing's XB–47.
188. Cited in Mills, *Power Elite*, 214-15.
189. Pattillo, *Pushing the Envelope*, 165.
190. Memo, Maj. Gen. Francis H. Griswold, Assistant Deputy Chief of Staff, Materiel, for Mr. W. Stuart Symington, 27 February 1950, sub: Brief of Current Status of Chase Aircraft Company, folder 160, Chase Aircraft Co., 1950, box 17, entry 377A, RG 341.
191. Near the end of April 1951, after the Air Force had already decided not to award the contract to Chase, Ryan visited Brig. Gen. N. S. Talbott, deputy director of field operations in the Air Materiel Command's Directorate of Procurement and Industrial Planning. Talbott reported that Ryan wanted to know if anything could be done to obtain a contract for Chase to produce C–123s. Also, according to the general, Ryan said "he had been with Stroukoff for seven years and that Stroukoff consistently refused to take advice from his people. . . . He [also] said that Stroukoff had not spoken to him personally for the last several months and ended up making the statement that he did not know how anyone could control Stroukoff." See memo (Talk with Mr. Ryan, Chase Aircraft Company), Brig Gen. N. S. Talbott, 2 May 1951, folder 160, 1951, box 47, entry 377A, RG 341.
192. Memo, Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel, and Michael Stroukoff, President, Chase Aircraft Co., Inc., for Maj. Gen. O. R. Cook [director, procurement and industrial planning, Air Materiel Command], 7 March 1951, ibid. Whether Wolfe, in co-signing the memorandum, was endorsing Stroukoff's plan or simply verifying its authenticity is not clear.
193. Ibid.
194. After graduating from the Air Service Engineering School in 1921, Kenney served as an Air Service representative at a bomber manufacturing plant, and then in the Air Service's Engineering Division until 1925. From late 1939 until early 1942, he was second-in-command of the Air Corps Materiel Division and simultaneously commander of the Experimental Depot and Engineering School that tested and evaluated new aircraft. See Thomas E. Griffith, Jr., *MacArthur's Airman: General George C. Kenney and the War in the Southwest Pacific*, 20-21, 41-42.
195. John Schlight, "Elwood R. Quesada: Tac Air Comes of Age," in *Makers of the United States Air Force*, ed. John L. Frisbee, 199-203.
196. Herman S. Wolk, "George C. Kenney: The Great Innovator," ibid., 146-48.
197. Ltr, Maj. Gen. Orval R. Cook, Director, Procurement and Industrial Planning, Air Materiel Command, to Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel, 16 April 1951, folder 160, 1951, box 47, entry 377A, RG 341. Cook's letter was marked "Personal."
198. Ibid. In another letter, styled in a military format and dated the same day, Cook omitted

any reference to "ex-Air Force officers" but stated, based on an Air Materiel Command study of Chase's ability to produce the C–123, that the company "falls short of meeting requirements necessary to successful accomplishment of this program." See ltr, Cook to Wolfe, 16 April 1951, sub: Procurement of C–123 Aircraft, ibid.

199. Ibid. (quotation from letter marked "Personal"). At an interdepartmental meeting in the summer of 1952, Cook likened aircraft manufacturers to automobile salesmen. See minutes, Defense Production Administration, Aircraft Production Board meeting, 9 July 1952, 11, encl. to ltr, Allen C. Rankin, Aircraft Production Board, to R. L. Gilpatric, Under Secretary of the Air Force, 14 July 1952, folder 334, Campbell Report (Aircraft Production Board), box 57, entry 377A, RG 341. After retiring from the Air Force in 1956, Cook served for five years as president of the Aircraft Industries Association. Presumably he did not repeat the characterization at gatherings of that group.

200. Kenney never took a job in industry; he served as president of the Air Force Association. Quesada became an executive with Olin Industries and with Lockheed.

201. Memorandum for record, Maj. Gen. Orval R. Cook, 10 May 1951, sub: Visit of Mr. Henry J. Kaiser and Mr. Edgar Kaiser, folder 160, 1951, box 47, entry 377A, RG 341; Donald E. Wolf, *Big Dams and Other Dreams: The Six Companies Story*, 232-33; and Pattillo, *Pushing the Envelope*, 165-66.

202. For the history of Thompson Products, Ramo-Wooldridge Corporation, and TRW, see Davis Dyer, *TRW: Pioneering Technology and Innovation since 1900.*

203. Ltr, J. D. Wright, Vice President and General Manager, Thompson Products, Inc., to Brig. Gen. A. H. Johnson, Air Materiel Command, 26 March 1951, folder 160, Thompson Products, box 37, entry 377A, RG 341.

204. Ltr, J. D. Wright to Brig. Gen. H. A. Shepard [director, procurement and production engineering, Office, Deputy Chief of Staff, Materiel], 9 April 1951, ibid.

205. To leave the Air Force, Shepard would have to resign his commission. Since he entered the service in 1934, he lacked the requisite twenty years to be able to "retire."

206. Ltr, John A. McCone, Under Secretary of the Air Force, to Frederick C. Crawford, President, Thompson Products, Inc., 14 May 1951, ibid.

207. Ltr, Crawford to McCone, 22 May 1951, ibid.

208. Memo, Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel, for Mr. McCone, 26 May 1951, folder 300, Administration, Management, 1951, box 39, ibid.

209. Ltr, John A. McCone, Under Secretary of the Air Force, to James M. Mead, Chairman, Federal Trade Commission, undated but signed encl. to ltr, McCone to Crawford, 1 June 1951, ibid. Crawford replied to McCone that the Air Force's letter was "exactly what we want" and that it would be attached to Thompson's request to the Federal Trade Commission to postpone the hearings. Crawford also wrote that, at McCone's suggestion, he had called on Edwin T. Gibson, acting administrator of the Defense Production Administration in the Office of Defense Mobilization. The day after the visit, Gibson's assistant told Crawford that the agency had prepared a letter for the Federal Trade Commission "which gives double support to our request." See Crawford to McCone, 6 June 1951, ibid.

210. See encl. to ltr, H. A. Shepard to Capt. Parke H. Tamplin, Chief Contractor Relations Branch, Air Materiel Command, 10 October 1952, folder 160 A-Z, 1952, box 56, entry 377A, RG 341. Why did the Air Force let Shepard go early in September when it had refused to do so just a few months earlier? In the summer and fall of 1951, production was just getting under way and encountering difficulties. Presumably Shepard, with an extensive background and experience in acquisition would be needed more than ever. One possible explanation is that Shepard made the kind of mistake that has terminated more than one promising military career—he embarrassed his boss by providing erroneous information to the latter's boss—in this instance the chief of staff of the Air Force. At the end of May 1951, Shepard had informed General Twining, the vice chief of staff, that an additional $1.3 billion would be needed to fund projected aircraft procurement. The figure was then given to General Vandenberg for use

in testifying before Congress. The correct amount, however, was $6.5 to $7 billion—a huge discrepancy. Shepard's boss, Lt. Gen. K. B. Wolfe, who reported directly to Vandenberg, was forced to withdraw Shepard's memorandum. Since Shepard's word would no longer be relied on at headquarters and further advancement was not likely, all concerned probably concluded that resignation would be in his and in the Air Force's best interest. For Shepard, all ended well. He eventually became chairman of the board and chief executive officer of TRW. See memo, Brig. Gen. H. A. Shepard, Director, Procurement and Production Engineering; Office, Deputy Chief of Staff, Materiel, for the Vice Chief of Staff, 24 May 1951, sub: Fiscal Year 1952 Aircraft Funds; memo, JCS [Lt. Col. J. C. Sherrill, executive assistant to the vice chief of staff] for General Twining, 26 May 1951; memo, Maj. Gen. Walter E. Todd, Assistant for Programming, Office, Deputy Chief of Staff, Operations, for General Shepard, 29 May 1951; memo, JCS for General Twining, 31 May 1951: all in folder Reading File, May 1951, box 54, Twining Papers, LC; and memo, John A. McCone, Under Secretary of the Air Force, for the Chief of Staff, 30 August 1951 [approving "retirement" for Shepard], folder Assistant Secretary of the Air Force, box 38, Vandenberg Papers, LC. For Shepard's career at TRW, see Dyer, *TRW.*

211. Ltr, Lyndon B. Johnson, Chairman, Senate Preparedness Investigating Subcommittee, to Thomas K. Finletter, Secretary of the Air Force, 29 March 1952, folder Secretary of the Air Force (2), box 62, Vandenberg Papers, LC. See also ltr, Finletter to Honorable George Smathers, United States Senate, 11 December 1951, folder Secretary of the Air Force (2), box 61, ibid.

212. Memo, Maj. Gen. Carl A. Brandt, Director of Requirements, Office, Deputy Chief of Staff, Development, for General Wolfe, Deputy Chief of Staff, Materiel, 12 July 1950, sub: Procurement of 8 CM [centimeter] Swiss Aircraft Rocket; msg, HQ USAF AFMPI, Washington, D.C., to USAIRA [U.S. Air Attaché], Bern, Switzerland, 14 July 1950 (Pass to Lieutenant General Chidlaw [commander, Air Materiel Command, who was then in Switzerland] from Lieutenant General K. B. Wolfe); and ltr, Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel, to Commanding General, Air Materiel Command, 1 August 1950, sub: Oerlikon: all in folder Foreign Armament Items, #1, box 13, entry 452 (Deputy Chief of Staff, Materiel; Director of Procurement and Production; Production Engineering Division; General File, 1950–1952), RG 341.

213. Memo, Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel, for General Saville [Lt. Gen. Gordon P. Saville, deputy chief of staff, development], 16 November 1950, sub: Evaluation of Swiss and Swedish Aircraft Armament Items, ibid.

214. Ltr, Maj. Gen. Carl A. Brandt, Assistant Deputy Chief of Staff, Materiel, to Maj. Gen. Bryant L. Boatner, Commanding General, Air Proving Ground, 26 January 1951, folder 323 thru 324, 1951, box 49, entry 377A, RG 341.

215. Although the Air Force became independent in 1947, it continued to rely on the other services to perform certain activities on its behalf. One of these was aircraft armament development. Under the authority of the National Security Act, the Munitions Board had assigned this responsibility to the Army's Ordnance Corps.

216. Report of the Shanahan Committee for the Study of USAF Armament Problems, 10 April 1951, encl. to memo, Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel, for the Chief of Staff, 15 May 1951, folder 334, 1951, box 49, entry 377A, RG 341. The Shanahan Committee (named for its chairman, Paul E. Shanahan of the University of Chicago) convened on 2 April 1951 and issued its report barely a week later. Charles A. Lindbergh was a part-time consultant to the committee.

217. Memo, Lt. Gen. K. B. Wolfe, Deputy Chief of Staff, Materiel, for the Chief of Staff, 15 May 1951, ibid.

218. Ibid.

219. Memo, Vandenberg for Deputy Chief of Staff, Materiel, 23 May 1951, ibid.

220. Memo, John H. Lewis for General Shepard, 25 September 1950, folder Foreign Armament Items, #1, box 13, entry 452. Lewis attended the meeting; Shepard worked directly for Wolfe.

221. Ltr, Oerlikon Machine Tool Works, Buehrle & Co., to Lt. Gen. K. B. Wolfe, Deputy

Chief of Staff, Materiel, 16 May 1951, encl. to memo, Maj. Gen. Carl A. Brandt, Assistant Deputy Chief of Staff, Materiel, for Hon. John A. McCone, 21 May 1951, sub: Procurement of Swiss Armament Items, folder Foreign Armament Items, #2, box 14, ibid.
222. Ltr, K. B. Wolfe, President Oerlikon Tool and Arms Corporation of America, to Asheville Industrial Council, 17 March 1952, folder Oerlikon Tool and Arms Corporation, ibid.
223. Orval R. Cook, interview by Hugh N. Ahmann and Maj. Richard Emmons, U.S. Air Force Oral History Program, 4–5 June 1974 and 6–7 August 1974, Washington, D.C., 387, file K239.0512-740, AFHRA; copy in AFHSO.
224. Ibid., 388.
225. Ibid., 388-89.
226. Memo, Gen. N. F. Twining, Vice Chief of Staff, for Deputy Chief of Staff, Development; Deputy Chief of Staff, Materiel, 16 April 1952, sub: Air Force Position Concerning Armament Development and Production, folder Reading File, April 1952, box 56, Twining Papers, LC.
227. Ltr, Lt. Gen. Laurence S. Kuter, Deputy Chief of Staff, Personnel, to Lt. Gen. Leon Johnson, 1 October 1952, folder Reading File, October 1952, box 57, Twining Papers, LC. Kuter was the first commander of the joint-service Military Air Transport Service. After retiring from the Air Force in 1962, he became an executive with Pan American World Airways.
228. The copy of the letter in Twining's papers at the Library of Congress is not signed, bears Twining's handwritten initial "T," the handwritten word "Hold," as well as the stamps "Noted by the Vice Chief of Staff" and "Information Copy for General Twining."
229. See note, Lt. Col. James C. Sherrill, Executive Assistant, Office of the Vice Chief of Staff, no date (but shortly after 12 March 1953), folder Reading File, March 1953, box 58, Twining Papers, LC.
230. Ltr, Hoyt S. Vandenberg, Chief of Staff, to Commanding General, Air Materiel Command [and various other commanders], 12 December 1950, sub: Standards of Conduct for Air Force Personnel Engaged in Procurement Activities, folder AF Reg. 30-30, 1949–1951, box 90, entry 481, RG 341 [italics in original].
231. Dwight D. Eisenhower, "Farewell Radio and Television Address to the American People," 17 January 1961, *Public Papers of the Presidents of the United States: Dwight D. Eisenhower, 1960–1961*, 1035-40.

I. Sources: James C. Olson, *Stuart Symington: A Life*, 11-13, 73-207; W. Stuart Symington, interview by Dr. George M. Watson, Jr., U.S. Air Force Oral History Program, 21 October 1981, 31-32, file K239.0512-676, Air Force Historical Research Agency, Maxwell Air Force Base, Alabama (quotation); George M. Watson, Jr., *Secretaries and Chiefs of Staff of the United States Air Force: Biographical Sketches and Portraits*, 13-16; and George M. Watson, Jr., *The Office of the Secretary of the Air Force, 1947–1965*, 38-39, 46-49, 51-53, 61-64, 69-79, 99-101.

II. Sources: Wayne Biddle, *Barons of the Sky*, 81-87, 96-99, 106, 122-24, 129-37, 180-85, 244-53, 271-72, 276-77, 288-89, 315-19 (quotation, 318-19), 323-24; Irving Brinton Holley, jr., *Buying Aircraft: Matériel Procurement for the Army Air Forces*, United States Army in World War II, 561, 577; and Wilbur H. Morrison, *Donald W. Douglas: A Heart with Wings*.

III. Sources: Memo, Roswell L. Gilpatric, Under Secretary of the Air Force, for the New Secretary and Under Secretary of the Air Force, 31 December 1952, 12, folder 321.1, Organization and Policy, box 12, entry 10, RG 341; Charles J. V. Murphy, "The Blowup at Hughes Aircraft," *Fortune* 49, no. 2 (February 1954): 116-18, 188, 190, 192-94, 197-98, 200 (Talbott quotation, 198); Noah Dietrich and Bob Thomas, *Howard: The Amazing Mr. Hughes*, 259-70; Barlett and Steele, *Empire*, 170-74, 186-95; Ramo, *Business of Science*, 36-77; and Richard Hack, *Hughes: The Private Diaries, Memos and Letters*, 209-13.

CHAPTER VII

Decentralization and Fragmentation: The Navy and Acquisition, 1945–1953

In the first few years following World War II, the services fought hard with one another over the organization of the postwar military establishment and the roles and missions each would be assigned. The struggle significantly affected acquisition. In the Navy, the effects were especially far reaching. To some extent, the contest influenced the Navy's choice of systems to be developed. But its greatest impact was on the organization and management of the Navy's acquisition programs. In those areas, the consequences resonated into the next decade and beyond.

The services had distinctly different conceptions of how the postwar military establishment should be organized. The War Department advocated a centralized structure comprising land, sea, and air branches unified in one department that would be headed by a civilian secretary advised by a single military chief of staff. In contrast, the Navy insisted that separately administered military departments coordinating their activities through interservice boards and committees, as had been the pattern during the war, would better serve the nation. The Navy believed that in a centralized defense arrangement, the ground and air arms would ally against the naval arm to further their own interests. As a result, naval capabilities such as the combination of sea-air power that had proven to be so important to victory in World War II would be neglected. Indeed, many in the Navy feared that the air arm would take over naval aviation and the ground arm would absorb the Marine Corps.[1]

To support its position in favor of a decentralized defense setup, the Navy pointed to the wartime success of its highly decentralized acquisition organization and to the ill effects that allegedly would occur if logistics functions were consolidated as proposed by some proponents of centralization. In statements submitted to the Senate Naval Affairs Committee in mid-1946, the Navy's top materiel officers made several arguments. They claimed the fleet received its quickest and most effective support through direct contact with acquisition organizations that specialized in a particular type of commodity and were responsible for developing, purchasing, and testing that product. They also maintained that centralization tended to eliminate the "healthy" competition that encouraged innovation and resulted in new developments and technical advances. Additionally, in a perspective more characteristic of the Navy than the other services, the admirals emphasized that people and their relationships mattered more in achieving successful programs than the form of an organization per se.[2]

The military establishment created by the National Security Act of 1947 more nearly approximated the defense organization preferred by the Navy than the centralized framework desired by the War Department. That the apparent victory had been won under the flag of decentralization seemed a powerful endorsement of the Navy's approach to acquisition. But, as the Navy sought to equip its forces with the most advanced weapons technologies following World War II, some in the service began to find that its decentralized and fragmented acquisition structure worked against achieving this objective.

This chapter examines the operation of the Navy's organization for acquisition through case studies of several weapons programs. These include two systems related to the acquisition of a nuclear weapons delivery capability, the North American AJ–1 heavy attack aircraft and the aircraft carrier *United States*; and two Marine Corps amphibious tracked-landing vehicles, the LVTP–5 and LVTH–6. Although these examples illustrate some of the strengths of acquisition in the Navy, they also reveal some significant weaknesses.

AN OVERVIEW OF THE NAVY, 1945–1953

At the end of World War II, the Navy was unchallenged on the seas. Its fleet of almost 2,500 major combatant vessels (aircraft carriers, battleships, cruisers, destroyers, destroyer escorts, and submarines) and amphibious transports was nearly twice the size of the British and Dominion navies put together. Its aviation component numbered 99 aircraft carriers and more than 41,000 aircraft. Its almost 4 million personnel included a ground force of close to 500,000 Marines organized in 6 divisions.[3] With the carrier task force as its principal offensive instrument, the Navy had destroyed the Japanese fleet and merchant marine. It had also projected power ashore with amphibious assaults on Japanese-held Pacific islands and with air attacks on Japan itself. During the next five years, however, the Navy encountered some rough waters at home. On balance, the service did not fare well during these stormy times. On the eve of the Korean War, the Navy's power and prestige had diminished appreciably; the future of naval aviation especially seemed in doubt. But by the end of the war, the Navy had regained its strength and reestablished its importance in the nation's defense posture.

Many factors influenced the Navy's acquisition programs during this turbulent period. The most important were the emergence of the Soviet Union as the nation's most likely enemy, the interservice contest over roles and missions, the "boom and bust" cycle of postwar military budgets, and the difficulties associated with exploiting and adjusting to new warfare technologies.

After World War II, the developing confrontation between the United States and the Soviet Union forced the Navy to make major adjustments, particularly to shift its focus from the Pacific Ocean to the Atlantic Ocean and the Mediterranean Sea. Visits by Navy warships to ports in Turkey, Greece, and Italy during 1946 were harbingers of the permanent U.S. naval presence in the Mediterranean that the Sixth Fleet later represented.[4] More problematic for the Navy than geographic reorientation was finding ways to apply naval power against an opponent that possessed formidable ground forces but that, unlike Japan, lacked a navy of any consequence and could not be reached easily from the sea. Traditional naval theory held that the main purpose of a navy was to defeat another navy. Thus a nation built a fleet superior in size and composition to that of its principal adversary. But since the Soviet surface fleet was small and without aircraft carriers, the Navy was hard-pressed to justify a large postwar surface fleet by this standard.[5] In World War II, however, the Navy had demonstrated that naval power could be extended effectively to targets on land as well as against an opponent's fleet. The problem with rationalizing large and powerful naval forces on this basis in 1945 was that most of the Soviet Union lay beyond the range of bombing planes then in the postwar Navy's inventory. To reach key Soviet targets, the Navy developed long-range aircraft that could carry both conventional and atomic bombs, modified its aircraft carriers to handle the first-generation of nuclear weapons–capable planes, and planned a new, 65,000-ton flush-deck "supercarrier" that could operate even larger and more powerful aircraft.

Although the threat from the USSR's surface fleet appeared negligible, the Navy was concerned about Soviet submarines. Toward the end of World War II, the Germans had developed submarines with high-speed diesel engines and snorkels (a "breathing" apparatus that enabled a submarine to operate submerged for long periods). With such technologies, submarines were better able to evade detection by aircraft, the principal means used by the Allies to neutralize German U-boats during the war. As the Soviets advanced from the east and overran German submarine production facilities, they obtained access to these technologies. Since Soviet submarines equipped with high-speed diesel engines and snorkels would be more difficult to locate and destroy, the Navy sought to improve its antisubmarine warfare technologies, such as depth charges, torpedoes, and sonar, and introduce new weapons such as Weapon Alfa, an antisubmarine rocket that could be fired from surface ships. Before the end of the Korean War, the Navy also converted *Fletcher* and *Gearing*-class destroyers, and developed new vessels such as the cruiser *Norfolk*, two classes of destroyers (*Mitscher* and *Dealey*), and special hunter-killer submarines (*Barracuda* class) to defeat the Soviet subsurface fleet.[6] Besides searching for submarines at sea, the Navy also planned to attack them "at the source"—to strike Soviet submarine bases, and production and assembly facilities with long-range, heavy attack aircraft launched from aircraft carriers.[7]

By 1949, Soviet submarine capabilities had not advanced as rapidly as initially anticipated. While submarines remained a potential threat, planners began to worry about Soviet land-based airpower's ability to challenge the Navy's control of the sea lines of communication.[8] Some thought this new danger should be met by intercepting Soviet aircraft as they approached the fleet. But others considered the most effective response to be air attacks on Soviet air bases.[9]

In acquiring a long-range, carrier-based nuclear weapons delivery capability, the Navy ran afoul of the newly independent Air Force, which viewed such activities as infringing on its responsibility for strategic air operations—attacks against urban, industrial, and military targets designed to undermine the opponent's will and capability to resist.[10] For its part, the Navy was not willing to cede complete responsibility for strategic air operations to the Air Force, let alone hegemony over the atomic bomb. In late 1947, on the eve of his retirement, Fleet Admiral Chester W. Nimitz, the Navy's chief of naval operations (CNO), indicated that the Navy might have a role to play in strategic bombing: "For the present, until long-range bombers are developed capable of spanning our bordering oceans and returning to our North American bases, naval air power launched from carriers may be the only practicable means of bombing vital enemy centers in the early stages of a war."[11]

In 1948, conferences attended by the secretary of defense and the Joint Chiefs of Staff at Key West, Florida, and Newport, Rhode Island, seemed to clarify Air Force and Navy roles with respect to strategic bombing. The participants agreed that the Air Force would have primary responsibility for strategic air warfare, but that the Navy would have access to nuclear weapons and also would be allowed to engage in strategic air operations.[12]

Naval historians do not agree on the extent to which the Navy desired to conduct strategic air warfare during this period. At least one believes that, beginning in 1948, as budget reductions forced increasing emphasis in war planning on a strategic air offensive employing nuclear weapons and intensified the competition for defense dollars, the Navy actively sought a substantial role in this mission.[13] Other scholars maintain that strategic bombing was a secondary consideration; the Navy's primary interest was attacking targets on land such as submarine pens and air bases that threatened its ability to control the sea lanes.[14]

Whatever the Navy's intent with respect to strategic bombing, the development of systems such as the flush-deck supercarrier that enhanced its ability to deliver nuclear weapons appeared to many in the other services, in Congress, and in the general public to duplicate unnecessarily the capabilities of the Air Force's strategic bombers, especially the long-range B–36. Consequently, in April 1949, Louis Johnson, who had become secretary of defense only the previous month, suddenly ordered a halt to construction of the flush-deck supercarrier, designated *United States*, without consulting the Navy's civilian and uniformed leadership. Angered by Johnson's arbitrary action, Secretary of the Navy John L. Sullivan resigned, as did Under Secretary W. John Kenney.[15]

Following cancellation of *United States*, the interservice dispute over roles and missions was publicly and acrimoniously aired during two-part hearings before the House Armed Services Committee in the late summer and early fall of 1949. The first hearings focused on alleged irregularities in the acquisition of the B–36. The Navy's credibility was undermined by the revelation that one of its civilian employees had written an anonymous document charging Secretary of the Air Force Symington and Secretary of Defense Johnson with a conflict of interest. The document claimed that the two officials favored procurement of the aircraft because of their previous business and social connections with Floyd Odlum, president of Convair, the plane's builder (see chap. 6). The second set of hearings centered on the relative merits of the B–36 versus the supercarrier and on the effectiveness of strategic bombardment. Francis P. Matthews, the newly appointed Navy secretary, appeared before the committee and played down the importance of the B–36 versus supercarrier controversy, attributing it to a small number of naval aviators unhappy with the cancellation of *United States* and other cuts in naval aviation. Several of the Navy's highest-ranking officers, including Admiral Louis E. Denfeld, the chief of naval operations, followed with testimony that took a much different tack. While sharply criticizing the B–36 and strategic bombardment, they also vigorously affirmed the value of the supercarrier and naval aviation. This episode, known as the "revolt of the admirals," resulted in the firing of Admiral Denfeld, who had publicly contradicted not only the views of the secretary of the Navy, his immediate civilian superior, but also those of the secretary of defense.[16]

In addition to creating turmoil within the Navy's top leadership, the roles-and-missions fight with the Air Force had serious consequences for naval aviation. Believing that it must be able to deliver nuclear weapons or lose out in the postwar competition between the two services, the Navy accelerated the acquisition of an aircraft that could carry an atomic bomb and operate from an aircraft carrier. But design deficiencies and insufficient testing of this plane, the AJ–1 Savage, resulted in the loss of numerous lives. The perception that the Navy's effort to develop a capability to deliver nuclear weapons by air stemmed from rivalry with the Air Force also contributed to decreases in funding for operation of the Navy's attack carriers. In FY 1949, 11 attack carriers were in service; in FY 1950, Congress appropriated money to support only 8; and for FY 1951, Secretary of Defense Johnson planned to cut the number to 4.[17] Furthermore, the cancellation of *United States* meant several years' delay in providing the fleet with a new attack carrier. The supercarrier had been scheduled for completion in 1952; the carrier *Forrestal*, its replacement, would not be commissioned until 1955. But even had the Navy not sought a long-range nuclear weapons delivery capability, the larger and heavier, high-performance jet aircraft then being designed and developed meant that a new carrier still would have been necessary.[18]

In the almost five years between World War II and the Korean War, nothing influenced acquisition in the Navy more than the lack of funds stemming from the Truman administration's desire to hold down military spending. The FY 1951 budget that originally provided for maintenance of only 4 attack carriers was the last in the postwar cycle of declining appropriations. The Navy, just as the other services, had suffered deep spending cuts during these years. For FY 1947, the first actual postwar budget, the Navy had requested $6.3 billion. Following reductions by the administration and Congress, only $4.1 billion was appropriated.[19] In the fiscal years thereafter, through the budget originally planned for FY 1951, the Navy received as little as $3.3 billion (FY 1948) and never more than $4.4 billion (FY 1949).[20] Force levels reflected the steep spending cuts. From a wartime peak of 1,307 major combatant vessels and almost 4 million personnel, the Navy's strength had fallen to 238 major combatants and just over 450,000 personnel in June 1950—a reduction of more than 80 percent.[21] Included in the Navy's force totals on the eve of the Korean War was a Marine Corps of fewer than 75,000 personnel in 2 reduced-strength divisions, a much smaller force than the Corps' leaders believed necessary to fulfill its missions.[22]

NAVY/MARINE CORPS ACTIVE FORCES
FY 1947–FY 1953

FY	1947	1948	1949	1950	1951	1952	1953
Major Combatant Vessels	297	277	272	238	342	400	409
Attack Carriers	11	11	11	7	12	14	14
Marine Divisions/ Wings [1]	2 (2R)/2	2 (2R)/2	2 (2R)/2	2 (2R)/2	2⅓/2	3/3	3/3
Personnel [2,3]	591	503	534	455	930	1,056	1,043

1. R = Reduced strength.
2. Personnel figures (in thousands).
3. Includes Marine Corps personnel.

Since the World War II shipbuilding program had provided the Navy with a large number of modern vessels (347 major combatants were in service at the time of Pearl Harbor), justifying ship construction after the war was extremely difficult.[23] Throughout the postwar period, funds for shipbuilding and modification of existing vessels (conversion) remained at low levels. In FY 1947, they amounted to $558 million in the Navy's budget of just over $4 billion, but dropped off sharply to $273 million in FY 1948, rose slightly to $303 million in FY 1949, and then fell back precipitously to only $147 million of the $4.1 billion budget for FY 1950.[24] In FY 1947, the Navy did not lay down the keel for a single ship.[25] Between the end of World War II and the start of the Korean War, construction had begun on only 14 major combatants—4 destroyers and 10 submarines.[26]

The relatively small amounts being spent on ship construction and conversion, along with the competition from the 10 government-owned naval shipyards, had depressed commercial shipbuilding, an industry that would be badly needed in the event of mobilization.[27] The number of private shipyards engaged in building vessels of 1,000 tons or more had plummeted from 88 in World War II to 8 in mid-1950. In July, Admiral Forrest P. Sherman, Denfeld's successor as chief of naval operations, wrote to Secretary Matthews: "The condition of the U.S. commercial shipbuilding industry is critical. Within a period of two years, under present conditions, this industry will cease to exist."[28]

The outbreak of the Korean War and presidential approval of the force levels recommended for NSC 68 resulted in a dramatic naval expansion. Supplemental appropriations tripled the $4 billion originally approved in the FY 1951 budget to $12.4 billion. In FY 1952, naval appropriations climbed sharply to $16.1 billion, but fell back to $12.6 billion for FY 1953.[29] By the end of the Korean War, the active fleet counted 409 major combatants and a total of 1,129 ships of all types.[30] The number of naval aircraft nearly quadrupled from 3,400 in FY 1950 to 13,400 in FY 1953.[31] The Marine Corps, engaged in bitter fighting with Communist forces on the Korean peninsula, expanded from 2 under-strength divisions to 3 full divisions and a total of 249,206 personnel.[32]

In designing the Navy's shipbuilding program, both Admiral Sherman and his successor, Admiral William M. Fechteler, sought to implement the concept of a "balanced" fleet. This meant primarily a fleet with attack carriers (eventually to be escorted by guided missile ships for protection) to control the sea lines of communication and to project power on shore, and with submarines and specialized surface ships to counter the Soviet undersea threat. But a balanced fleet also meant preserving traditional warships with tremendous firepower, such as battleships and cruisers.[33]

Recommissioning vessels taken out of "mothballs" (storage) accomplished much of the expansion that began in 1950. In this way, the Navy increased the number of attack carriers in service from 7 to 14, the number of battleships from 1 to 4, and the number of cruisers from 13 to 18.[34] Nearly 175 destroyers and destroyer escorts also came out of mothballs.[35]

The new construction that was authorized as part of the military buildup would add significant new major combatants to the fleet. They would include two new attack carriers, *Forrestal* and *Saratoga*; the first nuclear-powered warships, the submarines *Nautilus* and *Seawolf*; and a new destroyer class to be named for Admiral Sherman who died suddenly in July 1951.[36] The Navy also began converting two heavy cruisers, *Boston* and *Canberra*, into guided-missile ships.[37]

The new technologies of nuclear power and guided missiles that were incorporated in vessels in the shipbuilding program would become standard elements in the fleet of the future. But in the decade following World War II, such technological advances sometimes seemed as perilous as they did promising. The other side of the nuclear coin, for example, was the notion that the atomic bomb had made surface vessels so vulnerable that navies would no longer possess much utility in warfare. In July 1946, to counter this perception, the Navy exposed more than 80 U.S. and captured Japanese vessels, including all types of major combatants from aircraft carriers to submarines, to two nuclear explosions, one an airburst and the other an underwater detonation, at Bikini atoll in the South Pacific. Although the blasts sank or badly damaged many ships (depending on their proximity to the explosions), the Navy, supported by a formal Joint Chiefs of Staff evaluation of the tests, concluded that a fleet under way and operating in dispersed formation would be able to fight in a nuclear environment.[38]

As in the case of atomic energy, the advent of jet propulsion demonstrated the two-sided character of technological progress. The first Navy jets, McDonnell's FD–1 Phantom and North American's FJ–1 Fury, had begun development during World War II.[39] In July 1946, an XFD–1 Phantom was the first U.S. jet to take off from and land on an aircraft carrier, and in May 1948, VF–17A, equipped with McDonnell FH–1 Phantoms, became the Navy's first jet squadron to qualify in carrier operations.[40]

But despite these promising beginnings, deficiencies in another technology, the aircraft carrier, held back the Navy's ability to exploit jet power's potential. Neither of the Navy's most modern aircraft carriers, the three ships in the 45,000-ton *Midway* class (*Midway*, CVB-41; *Franklin D. Roosevelt*, CVB-42; and *Coral Sea*, CVB-43), nor those in the more numerous but smaller and older 27,000-ton *Essex* class, had been designed with jet aircraft in mind. Operating jets from them posed special problems. Heavier than the piston- engine aircraft of World War II, jets required stronger flight decks for landing, more deck space for takeoff, and boosts from more powerful catapults. Jets also landed at considerably higher speeds than propeller-driven aircraft.[41] For this reason, aircraft carriers needed stronger arresting cables to snag the jet's tailhook and stronger barriers to prevent the plane from crashing into deck personnel and other aircraft when the tailhook failed to engage the cable. Another obstacle to making the most of the jet's potential was the deck configuration of the *Midway* and *Essex* carrier classes. Their island superstructures limited aircraft wingspans and hindered all-weather operations. (This is why the flush-deck *United States* was designed without an island.) Their axial decks also became increasingly crowded as aircraft grew in size, preventing simultaneous launch and recovery operations.[42]

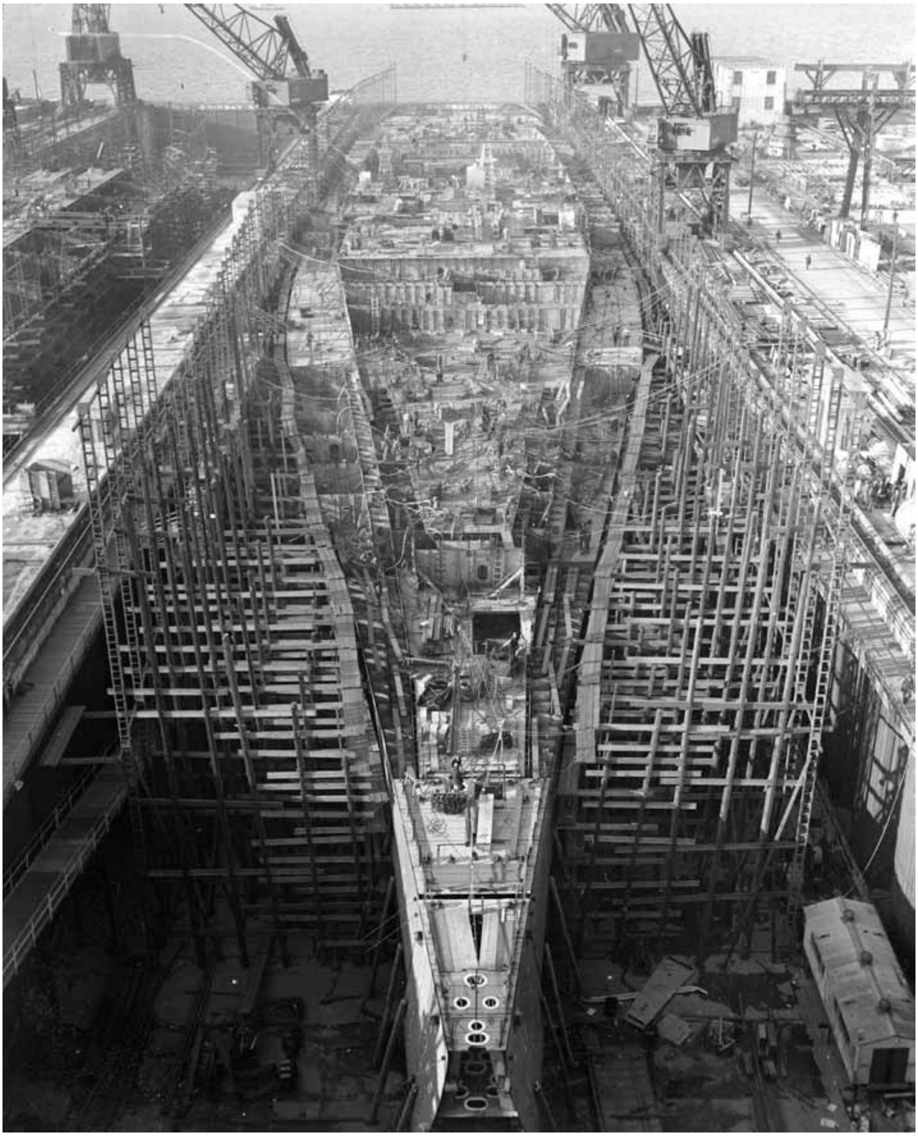
On the eve of the Korean War, the Navy's carriers could not accommodate further advances in jet aircraft technology. In April 1950, an officer assigned to the staff of the chief of naval operations (OPNAV) wrote one of the Navy's representatives on the Weapons Systems Evaluation Group that "the performance of many of our later planes has been reduced in an attempt to make the planes fit the carrier."[43] The heavy attack XA2J–1, a combined turbojet/turboprop version

USS *Midway* (CVB–41) off the Firth of Clyde, Scotland, September 1952, prior to angled deck-modification. Aircraft on her flight deck include AD Skyraiders, F4U Corsairs, and F9Fs. Courtesy, Naval History and Heritage Command.

of the AJ–1, exemplified this problem. To enable the XA2J–1 to operate even from a *Midway*-class carrier, the Navy had to reconfigure the original design that included a single turbojet engine and two turboprop engines by deleting the jet engine and reducing weight in other ways. As a result, the aircraft's speed and combat radius declined significantly.[44]

In the early 1950s, technology borrowed from the British enabled the carrier to keep pace with the jet. The most important innovation was the angled deck, described by one former naval aviator as the "savior of the tailhook Navy."[45] In this configuration, the carrier's flight deck became, in effect, two runways. One was the traditional axial arrangement paralleling the island superstructure. The second runway, the angled deck, was coincident with the axial deck at the aft end of the ship but proceeded at an angle to the left and away from the island superstructure. This angled-deck arrangement created more deck space, permitted the simultaneous launch and recovery of aircraft, and made flight operations much safer. In 1952, the Navy began modifying its attack carriers with angled decks, including *Forrestal*, already under construction.[46] A second British technological innovation adopted by the Navy was the steam-driven catapult that was capable of propelling a 70,000-pound aircraft to a speed in excess of 140 mph.[47]

Along with jets, the Navy began developing another new technology during World War II—the guided missile.[48] By the late 1940s, Navy missile projects covered the spectrum of potential uses—surface-to-air, air-to-air, surface-to-surface (including ship-to-shore and ship-to-ship), air-to-underwater, and underwater-to-surface.[49] But because of the complexity of missile technology rather than scarcity of resources, only two of these projects had advanced beyond research and development by 1953. In mid-1952, two Navy missiles, the surface-to-air Terrier and the air-to-air Sparrow, were being produced in significant quantities, but neither was operational before the end of the Korean War. In fact, no U.S. missile was operational by that time.[50]



With hull surrounded by scaffolding, USS *Forrestal* (CVA–59) is under construction at Newport News Shipbuilding and Dry Dock Co., Newport News, Virginia, January 1954.

USS *Forrestal* (CVA–59) in Mediterranean Sea, April 1957. Note the angled deck and large size of the A3D Skywarriors (located on the starboard side of the ship, aft of the island superstructure) relative to the other aircraft.
Courtesy, Naval History and Heritage Command.

The steadily increasing Soviet air threat to the fleet caused the Navy to give highest priority to air defense missiles.[51] In 1953, both of the most promising surface-to-air missiles followed a radar beam to their targets—the supersonic, rocket-powered Terrier, designed to engage oncoming aircraft at 20 to 40 miles, and the supersonic, ramjet-powered Talos, with a range of 50 to 100 miles. Development problems plagued both systems, and neither served with the fleet until 1960.[52] The Navy's air-to-air missiles became operational much sooner. Sparrow I, a radar-beam rider developed by the Sperry Corporation, was first tested successfully in 1951 and entered fleet service in early 1956.[53] In contrast to Sparrow I, Sidewinder was a heat-seeking, infrared missile and was designed and developed in a government laboratory, the Naval Ordnance Test Station at China Lake, California. In September 1953, Sidewinder scored its first hit on a drone aircraft, went into quantity production in 1955, and was operational by mid-1956.[54]

From 1945 to 1953, two surface-to-surface cruise missiles, Rigel and Regulus, competed for the land-attack mission. In August 1953, the Navy cancelled the supersonic Rigel, a ramjet with a 100-mile range that had been experiencing technical problems, in favor of the subsonic, 500-mile range Regulus that was propelled by the more familiar turbojet technology. Just over 41 feet in length, the nuclear-armed Regulus could be launched from aircraft carriers, cruisers, or surfaced submarines. The Navy declared the missile operational in 1954, but regular fleet deployment did not begin until 1955.[55]

The Air Force viewed the Navy's surface-to-surface missile program, particularly the proposed (but never produced) 2,000-mile range Triton, as rivaling its own Navaho and Snark cruise missile systems and as a threat to its strategic warfare responsibilities.[56] The Air Force's suspicions were but one of the many examples of interservice conflict over missile roles and missions that occurred in the 1940s and 1950s. During this same period, the competition and apparent duplication that characterized the services' missile programs were also replicated within the Navy. The intraservice contest between the Bureau of Aeronautics and the Bureau of Ordnance for responsibility, or "cognizance," over missiles grew out of the Navy's organizational structure for acquisition and, as discussed in the next section, reflected both its strengths and its weaknesses.

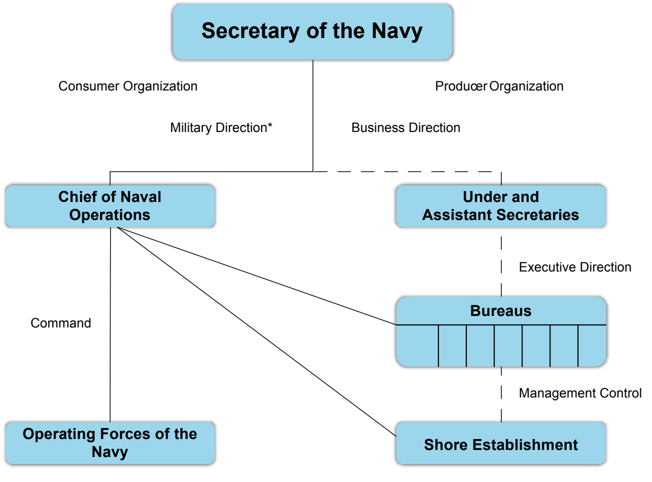
By the end of the Korean War, the Navy had regained much of the ground it had lost in the years immediately following World War II. Three major developments accounted for the reversal of the Navy's fortunes. First, the formation of NATO and the U.S. commitment to defend Western Europe enhanced the Navy's importance. Control of the sea lanes was necessary to support the European allies. The decision taken in late 1950 to oppose a Soviet advance as far east as possible, coupled with the appearance of smaller and lighter nuclear weapons soon thereafter, also enabled Navy carriers operating on NATO's southern and northern flanks to provide significant tactical air support to alliance ground forces. Second, the Navy's performance during the Korean War demonstrated the value of strong conventional naval power that could be projected at great distances and sustained for long periods. Finally, the budget increases between FY 1951 and FY 1953 resulted in an expanded and modernized fleet able to fulfill the Navy's worldwide commitments.

ORGANIZATION FOR ACQUISITION

More was demanded of acquisition in the Navy than in the other services. Naval forces required weapons and equipment for every warfare dimension—on and below the surface of the sea, in the air, and on the ground. Moreover, naval units such as carrier task groups, antisubmarine hunter-killer groups, and amphibious assault forces, employed a wide array of advanced systems in multiple environments simultaneously. During this period, for example, the typical carrier task group, the Navy's principal offensive force, comprised 4 aircraft carriers, each with more than 100 aircraft of different types, 6 cruisers, and 24 destroyers.[57] Ideally, the individual elements of such "systems of systems" should be developed with the operation of the whole in mind. But through the end of the Korean War the Navy's organization for acquisition remained highly decentralized and badly fragmented. These characteristics did not preclude development of outstanding weapons—the Sidewinder missile was a product of this structure. Nevertheless, as observers pointed out, such organizational arrangements did not lend themselves to achieving the integration of complex systems essential for naval forces to operate effectively.

Acquisition in the Navy took place under a "bilinear" organizational framework made up of two parallel command lines that divided "consumer logistics" from "producer logistics." Both channels flowed between the civilian secretary of the Navy and the technical bureaus that provided for the service's materiel requirements. In the consumer logistics track, the chief of naval operations, acting on behalf of the secretary of the Navy, identified the fleet's needs for weapons and equipment. These qualitative and quantitative requirements were formulated by the CNO's staff, OPNAV, and transmitted to the bureaus. Consumer logistics was thus the "naval command" or operational side of the service. In contrast, producer logistics, the second track, was the "business management" side of the Navy. It involved research, development, and procurement (purchase, production, supply) of materiel to satisfy the qualitative and quantitative requirements that had been identified by the chief of naval operations. The uniformed bureau chiefs carried out these activities, as well as the maintenance of related shore facilities, and reported to the secretary of the Navy through the civilian under and assistant secretaries.[58]

CONCEPT OF NAVY BILINEAR ORGANIZATION



* The commandant of the Marine Corps, under the secretary of the Navy, commands the Marine Corps and exercises "Management Control" over Marine Corps shore activities, unless they are otherwise assigned for this purpose.

Source: Adapted from NAVEXOS P–435 (Rev. 6 60), *The Department of the Navy*, June 1960

Analysis of the three major parts of the bilinear organizational framework—the Office of the Secretary of the Navy, the Office of the Chief of Naval Operations (OPNAV), and the technical bureaus—reveals structural and procedural faults that made weapon system integration difficult.

Acquisition was one of the secretary of the Navy's principal responsibilities. He divided its management between two immediate subordinates, the assistant secretary of the Navy and the assistant secretary of the Navy for air.[59] Oversight of the Navy's procurement was the principal responsibility of the assistant secretary of the Navy who carried out this function through the Office of the Chief of Naval Material, headed by an admiral.[60] The assistant secretary of the Navy for air provided policy direction for research and development.[61]

After World War II, the Navy paid special attention to its organizational arrangements for managing research. Like the other services, it had concluded that technological progress might be impeded if production dominated acquisition and overshadowed research. Early in 1946, an officer from the Material Division, predecessor of the Office of Naval Material, explained to an audience at the Industrial College of the Armed Forces that the Office of Research and Inventions (established in late 1945 and predecessor of the Office of Naval Research discussed below) had not been located in the Material Division to avoid "stultifying the initiative of the research gang."[62] To help ensure continued technological advances, the Army and Air Force sought to separate research and development organizationally from production—the Army on its headquarters staff, and the Air Force, not only on the Air Staff but also by creating an independent field command for research and development (see chaps. 4 and 5). The Navy took a different course. Instead of segregating research and development from production, it attempted to separate research from development.

The Office of Naval Research (ONR), established by Congress in 1946 and located organizationally under the assistant secretary of the Navy for air, reflected this objective. Headed by an admiral, the chief of naval research, the office's mission was to coordinate the Navy's research program, direct the activities of the Naval Research Laboratory, and contract for research with industry and with universities and other nonprofit institutions.[63] ONR's research orientation represented another conviction, especially strong in the Navy, that basic research—theoretical or experimental study directed toward the increase of knowledge, not necessarily aimed at a specific military use as was applied research—was the wellspring of technological advances.[64] According to Rear Adm. Paul F. Lee, chief of naval research in 1947, World War II had demonstrated that "from purely fundamental research studies comes knowledge which can have a profound effect upon the outcome of war."[65] Thus, the Office of Naval Research initially concentrated on basic research. But with declining postwar military budgets and the establishment of the National Science Foundation in 1950 to sponsor basic research, ONR came under pressure to increase applied research and to show that its basic research projects would benefit the Navy.[66]

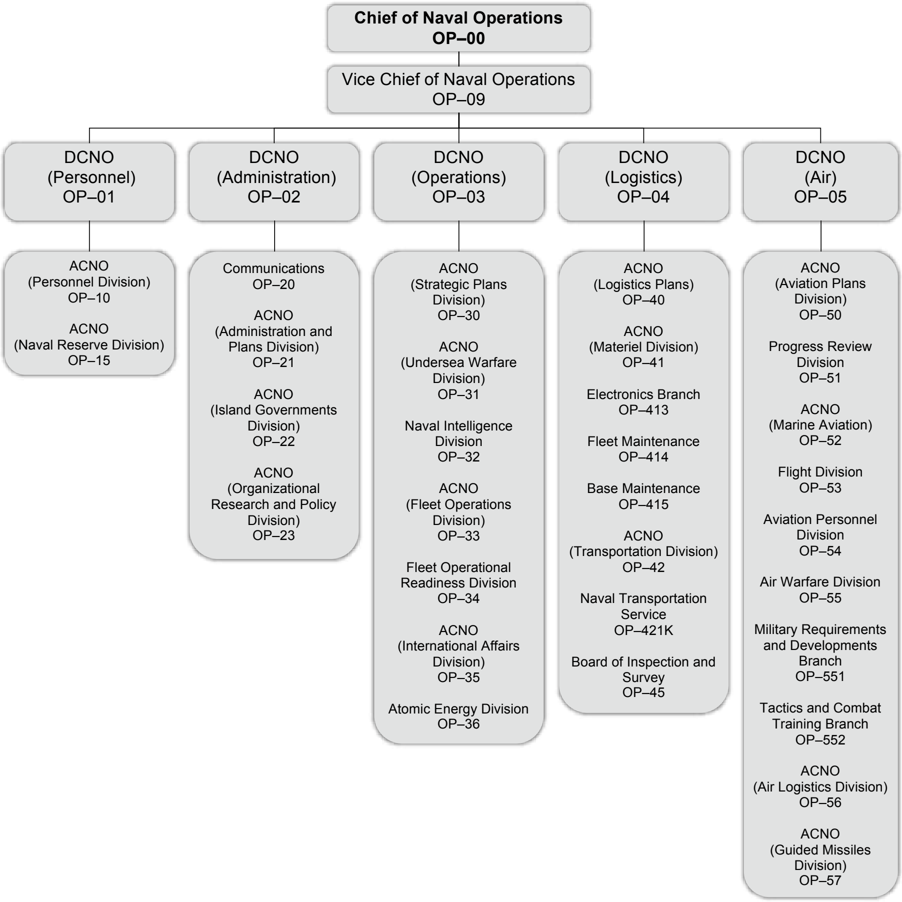
The Office of Naval Research did not engage in development. That function, including test and evaluation, was centered in the bureaus, although they also engaged in some applied research. By this general division of responsibilities between ONR and the bureaus, the Navy hoped to preserve the independence of research and prevent it from being overwhelmed by the short-term demands of production.

To provide outside expert advice for the Navy's research effort, Congress authorized the formation of the Naval Research Advisory Committee. Comprised of up to 15 outstanding scientists appointed by the secretary of the Navy, the committee was charged with advising the secretary, the chief of naval operations, and the chief of naval research on policy regarding basic research and the adequacy of ONR's research programs. The committee was effective in these limited respects, but it did not enjoy the broader influence over Navy research and development that the Air Force's Scientific Advisory Board exercised in that service.[67]

Despite the new organizational structure put in place after the war, there were gaps in headquarters' management of the research and development aspect of producer logistics. In keeping with the Navy's tradition of decentralization, the Office of Naval Research's authority was limited. It did not have the power to draw up the service's total research program and assign portions of it to the bureaus. Instead, ONR attempted to coordinate its program with those of the bureaus, which were free to initiate whatever research they believed appropriate.[68] Furthermore, no agency in the Office of the Secretary of the Navy, comparable to the Office of the Chief of Naval Material with respect to procurement, formulated policy for and coordinated the bureaus' development activities.

The producer logistics performed by the Office of Naval Research and the bureaus responded, at least theoretically, to the consumer logistics requirements generated in the Office of the Chief of Naval Operations, OPNAV. For the most part, OPNAV's organizational structure was a traditional functional arrangement with a deputy chief of naval operations each for personnel (Op–01), administration (Op–02), operations (Op–03), and logistics (Op–04). A fifth major staff element, the Office of the Deputy Chief of Naval Operations for Air (Op–05), departed from the functional pattern; it represented one of the Navy's three major "warfare" or "platform" communities. The others were surface warfare and undersea warfare, each with divisions—"desks"—in the Office of the Deputy Chief of Naval Operations for Operations (Op–03).[69]

OFFICE OF THE CHIEF OF NAVAL OPERATIONS (OPNAV)
January 1949



Source: Adapted from the chart (Office of the Chief of Naval Operations, January 1949), in Barlow, *Revolt of the Admirals*, 166.

For several years after World War II, OPNAV lacked a staff element solely responsible for transmitting requirements to the Office of Naval Research and to the bureaus. The various warfare desks in the Office of the Deputy Chief of Naval Operations for Operations (surface warfare, undersea warfare, and atomic warfare) and in the Office of the Deputy Chief of Naval Operations for Air (air warfare and guided missiles) issued requirements, subject only to the approval of their particular deputy chief, directly to the bureaus without further staff coordination. In late 1950, a reorganization created specially designated research and development billets in each of OPNAV's warfare divisions to formulate requirements. Additionally, the New Developments and Operational Evaluation Division was established under the deputy chief of naval operations for operations to review, coordinate, and issue all requirements on behalf of the chief of naval operations.[70]

The Operations Evaluation Group, the Operational Development Force, and the Ship Characteristics Board, all controlled by OPNAV, played significant roles in acquisition. Formed during World War II, the Operations Evaluation Group (originally the Antisubmarine Warfare Operations Research Group) performed operations analysis for the chief of naval operations.[71] In 1948, the group employed about 35 scientists, mostly mathematicians and physicists. It influenced requirements formulation through "analytical study of proposed new developments on the basis of specified characteristics . . . before any models [were] built."[72] Scientists from the group also worked closely with the Operational Development Force.[73] Part of the Atlantic Fleet, but controlled by the chief of naval operations for project assignments, the Operational Development Force evaluated newly developed systems under operating conditions and devised tactics for employing systems currently in service.[74]

Identifying ship requirements in OPNAV was a two-stage process. The deputy chief of naval operations for operations (Op–03), first determined for both new construction and conversions the type and number of vessels required along with their missions and supporting tasks.[75] Once ship type had been determined, OPNAV then decided the "naval characteristics for material to be procured or developed."[76] The Ship Characteristics Board, administered by the deputy chief of naval operations for logistics (Op–04), made recommendations pertaining to the material features of a ship that influenced its performance.[77] Normally chaired by Op–04, the board also included flag-rank officers (admiral or commodore) from the Office of the Deputy Chief of Naval Operations for Operations (Op–03), the Office of the Deputy Chief of Naval Operations for Air (Op–05), the Bureau of Aeronautics, the Bureau of Ordnance, the Bureau of Ships, and the Bureau of Naval Personnel.[78] The board's establishment in 1943 had reflected then CNO Admiral Ernest J. King's desire to gain greater control over the bureaus. Prior to the board's formation, the Bureau of Ships had submitted ship designs to the secretary of the Navy for approval through the General Board, bypassing the chief of naval operations.[79]

The creation of the Ship Characteristics Board, however, did not centralize management of this activity in one agency because the General Board continued to influence the Navy's shipbuilding program. Comprised of senior admirals appointed by the secretary of the Navy and usually nearing retirement, the General Board had provided advice on policy and strategy to the Navy's top leadership since 1900. The board's power had declined substantially during World War II, but it continued to review OPNAV's plans for ship design and for the construction and conversion program for several years following the war.[80] Sometimes the General Board did not agree with the recommendations made by the Ship Characteristics Board and the secretary of the Navy had to resolve the dispute. In such contests, the General Board was at a considerable disadvantage. For one thing, the admirals on the General Board did not usually possess recent fleet experience.[81] For another, the board lacked the staff support available to the

Ship Characteristics Board. Retired Rear Adm. Edward A. Ruckner, who served on the Ship Characteristics Board's staff for three years immediately after World War II, recalled how OPNAV overwhelmed the General Board in a disagreement over a design for a new destroyer:

> In order to carry this thing [the differing opinions] up to the Secretary, the staff prepared what we called a triple threat analysis. We took the General Board's recommendations for the design and we prepared three briefs of the analysis comparing the two designs. One was a very short one and just covered the salient points for those people who don't get a chance to read any voluminous documents. The second was a little more detailed. . . . And the third was a very thorough analysis.[82]

Without the technical expertise that would have been available from a staff, the General Board's recommendations were, in Ruckner's words, "more or less seat-of-the-pants decisions."[83] In March 1951, the secretary of the Navy dissolved the General Board, finally clearing the deck of any competitors to OPNAV's control of the ship program.

The two channels of policy direction, consumer logistics from OPNAV and producer logistics from the Office of the Secretary of the Navy, connected the service's headquarters to the bureaus. Since 1842, the Navy's technical bureaus had provided the materiel and personnel required by the operating forces. They possessed extraordinary autonomy and independence from other naval components and from each other. Seven were in existence at the end of World War II: the Bureau of Aeronautics, the Bureau of Medicine and Surgery, the Bureau of Naval Personnel, the Bureau of Ordnance, the Bureau of Ships, the Bureau of Supplies and Accounts, and the Bureau of Yards and Docks. Three of the seven—the Bureau of Aeronautics (BuAer), the Bureau of Ordnance (BuOrd), and the Bureau of Ships (BuShips)—acquired the Navy's major weapon systems. The Bureau of Aeronautics was responsible for aircraft and aviation equipment; the Bureau of Ordnance for "all offensive and defensive arms and armament" and control systems for guns, torpedoes, bombs, and rockets; and the Bureau of Ships for ships and small craft as well as radio and sound equipment.[84]

To carry out their missions, encompassing "cradle to the grave" responsibility for the systems under their purview, the three bureaus combined the resources of the private sector and their own in-house capabilities, with the Bureau of Aeronautics drawing more heavily on external support than either the Bureau of Ordnance or the Bureau of Ships.[85] From 1945 to 1953, the Navy expended about two-thirds of its annual research and development appropriation on contracts with industry and universities.[86] The Navy's in-house assets included an extensive network of laboratories and test and production facilities, nearly all maintained by BuAer, BuOrd, and BuShips. In 1946, in addition to the 11 shipyards belonging to the Bureau of Ships, the 3 bureaus operated and exercised virtually unfettered control over more than 25 major Navy-owned facilities devoted to research and development.[87]

After World War II, achieving effective coordination among the major elements of the Navy's fragmented and decentralized acquisition structure, especially between OPNAV and the bureaus and among the bureaus themselves, proved to be difficult. Initially, some thought informal liaison was all that would be required. In speaking to the Army Industrial College early in 1946, an officer from OPNAV acknowledged the existence of overlapping areas of responsibility, but asserted optimistically that "the answer to these problems is cooperation."[88] Before the same audience a few weeks later, an admiral assigned to the Office of Procurement (predecessor of the Office of Naval Material) described the disagreement between the Bureau of Ships and the Bureau of Aeronautics over which bureau should acquire airborne electronic equipment. Traditionally, he said, the Bureau of Ships had been responsible for the acquisition of electronic systems. But the Bureau of Aeronautics maintained that anything that went into a plane, electronic or otherwise, should come under its jurisdiction. Rather than ramming a policy decision down a bureau's throat, the admiral believed that "We can work out anything together."[89]

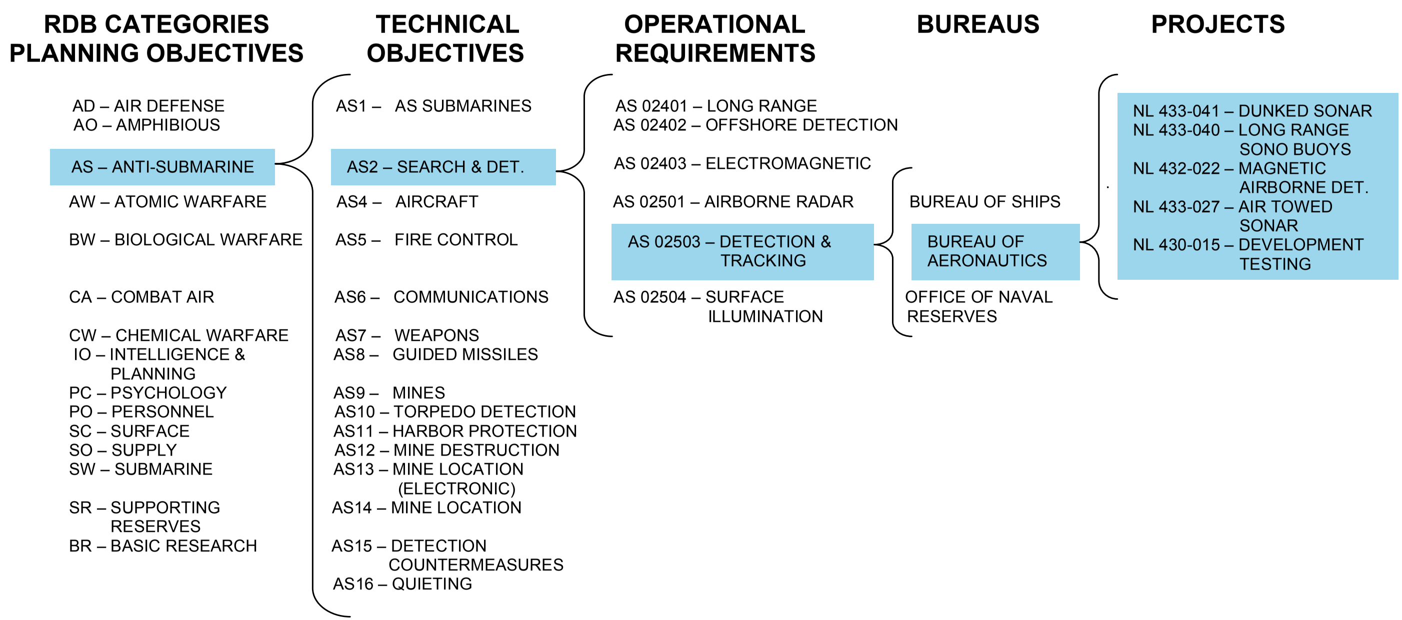
In addition to contacts between individuals, the Navy made considerable use of coordinating committees. Some were ad hoc bodies formed for a short-term purpose.[90] Others, such as the Inter-Bureau Technical Committee on Guided Missiles were long-lived. The latter was an outgrowth of a joint Bureau of Aeronautics–Bureau of Ordnance committee set up in November 1945. By early 1947, it also included the Bureau of Ships as a voting member and OPNAV and the Office of Naval Research as nonvoting participants. Its role was to review each bureau's guided missile program and recommend how these programs might be coordinated "along technical lines."[91] Issues that the committee could not settle were to be referred to the chief of naval operations for resolution.[92]

By 1948, the Navy had concluded that effective management of research and development required a formal process for linking requirements formulated by OPNAV to research undertaken by the Office of Naval Research and hardware developed by the bureaus.[93] The resulting system provided general guidance from OPNAV to the Office of Naval Research and to the bureaus in the form of 16 "planning objectives," each subsuming numerous "operational" and "research" requirements.[94]

All three guidance categories were cast in broad terms: a planning objective described "a scientific or operational problem" requiring solution with new knowledge or equipment; an operational requirement identified the "estimated operational performances" needed in a system developed to satisfy a planning objective; and a research requirement indicated the "scientific knowledge" that must be obtained to support the Navy's research and development program.[95] After promulgation by OPNAV, the bureaus and the Office of Naval Research used the planning objectives, operational requirements, and research requirements to formulate their annual programs, together totaling thousands of individual projects.[96]

NAVY RESEARCH AND DEVELOPMENT PROGRAM

Relationship between Department of Defense Research and Development Board Warfare Categories/Technical Objectives and Navy Planning Objectives /Operational Requirements/R&D Projects

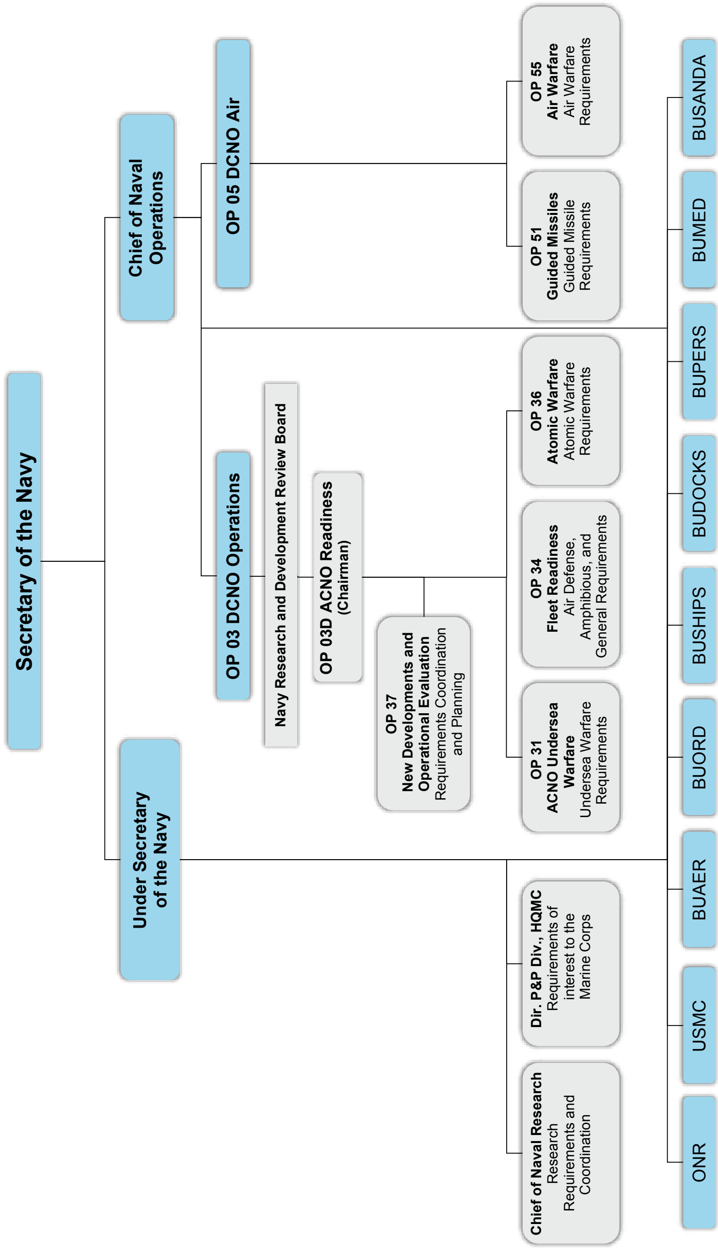


Source: Adapted from Chart 5 (Navy Research and Development), in “Review by the Deputy Secretary of Defense of Military Preparations Involved in the Implementation of NSC 68,” in folder CD 301 (War Plans, NSC 68, October 1950), box 201, entry 199, RG 330.

The principal organizational instrument for operating the planning system was OPNAV's Navy Research and Development Review Board. Chaired by the assistant chief of naval operations for fleet readiness (in Op–03, the Office of the Deputy Chief of Naval Operations for Operations), the board's other members included the chief of naval research, the assistant chief of naval operations for undersea warfare (also in Op–03), several division chiefs from Op–03 and from the Office of the Deputy Chief of Naval Operations for Air (Op–05), and the Marine Corps director of plans and policies.[97] The board's major duties were to formulate the planning objectives; to prepare the Navy's annual research and development plan; to assign priorities to the operational and research requirements; to review the research and development programs of the bureaus, the Office of Naval Research, and the Marine Corps; and to recommend the allocation of research and development funds to the Navy's Office of Budget and Review.[98] Although the board determined the priority of operational and research requirements, until late 1950 and the establishment of the previously discussed New Developments and Operational Evaluation Division in Op–03, the warfare divisions in OPNAV represented on the board drew up and issued the requirements independently.[99]

The Navy was ahead of the other services in implementing a planning system for research and development after World War II, but OPNAV's direction was not as firm or as comprehensive—and, in part, purposefully so—as the foregoing description of the process might imply. One characterization of OPNAV, often attributed to Admiral Arleigh A. Burke, chief of naval operations from 1955 to 1961, is that the staff was like 10,000 ants floating down the river on a log, all yelling "I got the conn" [i.e., control of a ship].[100] When it came to OPNAV's designation of research and development priorities before the Korean War, the ants-on-a-log simile seems particularly apt. Headquarters policy statements bearing on priorities for research and development often conflicted, creating uncertainty among the bureaus about the appropriate emphasis that they should apply in their programs. In 1949, for example, OPNAV assigned the "highest priority" to countering both the antisubmarine threat and the air defense threat. Acknowledging the inconsistency, OPNAV explained: "[T]he assignment of a high priority classification to certain programs is not to be interpreted as implying that all items of these programs take precedence over all items of other essential programs. It is expected that the cognizant Chief of Naval Operations' offices will resolve the relative priorities of the individual items of the various programs, giving due weight to the assigned program priorities."[101]

COORDINATION OF NAVY RESEARCH AND DEVELOPMENT
Navy Research and Development Review Board



Source: Adapted from Chart 2 (Coordination of Navy Research and Development) in "Review by the Deputy Secretary of Defense of Military Preparations Involved in the Implementation of NSC 68," in folder CD 301 (War Plans, NSC 68, October 1950), box 201, entry 199, RG 330.

The appropriate forum for sorting out such problems was the Navy Research and Development Review Board described earlier. But, as the board's chairman conceded in mid-1949, the "reviews previously conducted of the Navy's programs for assignment of priorities to projects and to assure that the allocation of funds was optimum, have been perfunctory."[102] Although OPNAV was aware that a problem existed concerning the ordering and dissemination of priorities, the situation did not improve quickly. Early in 1950, the chief of one of the bureaus advised the Office of the Deputy Chief of Naval Operations for Logistics (Op–04) that he was not sure which direction to channel funds and effort because directives issued from different sections in OPNAV were not coordinated as to urgency and priority.[103] In its April 1950 assessment of the Navy's undersea warfare program, the Low Board (named after its chairman Vice Adm. Francis S. Low) echoed the earlier judgment of the Navy Research and Development Review Board's chairman that OPNAV's review of priorities was essentially pro forma.[104] Since responsibility for research and development policy in OPNAV was fragmented among the Navy Research and Development Review Board and the warfare divisions, it is not surprising that its guidance was inconsistent.

But the absence of strong, centralized direction from OPNAV for research and development was partly intentional. At this time, the Navy preferred decentralization, and this view enhanced bureau independence. In 1951, OPNAV codified the procedures for coordinating the Navy's research and development program. The instruction emphasized the bureaus' freedom within the CNO's general guidance to initiate and prosecute any research and development projects that they thought were required. OPNAV and the Department of Defense's Research and Development Board would review the projects, but according to the instruction, such oversight was not to prevent "the Chief of a Bureau or Office from undertaking work on a research and development project at any time, with or without review, if he considers it necessary to provide for optimum fleet readiness within his area of responsibility, in support of an operational requirement, and within the limitations of funds available and any specific direction from the Chief of Naval Operations."[105]

Along with weak direction from OPNAV, the Navy's budget process also favored bureau autonomy. The bureaus put together annual budget estimates and submitted them to the Office of Budget and Reports, located organizationally in the Office of the Secretary of the Navy. The Office of Budget and Reports coordinated preparation of the annual Navy Department budget for approval by the secretary of the Navy in a process involving OPNAV (represented by the Navy Research and Development Review Board for the R&D portion of the budget) that resulted in an allocation of funds among the bureaus. The department's budget was then approved in turn by the secretary of defense and the president, via the Bureau of the Budget, and submitted to Congress. Until 1954, Congress appropriated funds directly to the individual bureaus, not to the Navy Department.[106] Once the appropriation had been made, the bureau chiefs could reprogram funds much as they saw fit.[107]

The relative independence the bureaus enjoyed, combined with the increasing tendency for weapon systems to cut across traditional product categories (Was a missile a bullet or an airplane?), resulted in program duplication and disputes among them regarding cognizance over system development. The disagreement, noted earlier, between the Bureau of Ships and the Bureau of Aeronautics concerning responsibility for airborne electronic equipment had begun during World War II, but was not resolved until early 1947 when the two bureaus finally agreed to transfer cognizance to BuAer.[108] In addition to airborne electronics, arguments over cognizance affected several other types of systems—the Bureau of Ordnance and the Bureau of Aeronautics with respect to aviation ordnance (guns, bombs, rockets);[109] the Bureau of Ships and the Bureau of Aeronautics for the primary role in the development of electronic equipment for all-weather flight operations;[110] and the Bureau of Ordnance and Bureau of Ships over torpedo countermeasures.[111]

Of all the conflicts over responsibility, inter-bureau rivalry in the guided missile field proved the most intense, the most enduring, the most expensive, and the most significant for the course of acquisition in the Navy. The Bureau of Ordnance and the Bureau of Aeronautics were the chief competitors. By the late 1940s, both were developing air-to-air, surface-to-air, and surface-to-surface missiles.[112] In 1947, Rear Adm. Daniel V. Gallery, chief of the Guided Missiles Division in the Office of the Deputy Chief of Naval Operations for Air, provided one view of the battle between the two bureaus:

> BuOrd and BuAer are very jealous of each other's efforts. BuAer feels that BuOrd is muscling in on their field and in my opinion they have invaded BuAer's field of cognizance . . . . BuOrd has the stronger motive to produce on guided missiles because if they don't . . . they become the Bureau of Obsolete Weapons, whereas BuAer's big interest is in aircraft which we know will be with us for some time."[113]

Eventually, the controversy reached the secretary of the Navy. Years later, Rear Adm. Alfred M. Pride, chief of the Bureau of Aeronautics from 1947 to 1951, recalled being summoned, along with the Bureau of Ordnance's chief, Rear Adm. Albert G. ["Chuck"] Noble, to the secretary's office. The secretary, Pride remembered, "gave us a little talking to. He said he wished we'd get together and one or the other of us would give up. I said I wouldn't and Chuck Noble said he wouldn't. So they could never get those two bureaus together to agree on the cognizance of certain missiles."[114]

Although consolidating the entire missile program under one of the bureaus was probably neither practical nor necessarily desirable, responsibility for particular types of missiles could have been divided between the two. But the Navy, preferring decentralization to centralization, chose to maintain the status quo.[115] In the spring of 1950, the report of a subcommittee of the department's Management Survey Board recommended that the two missile programs continue as before under the coordination of the assistant chief of naval operations for guided missiles in OPNAV (in the Office of the Deputy Chief of Naval Operations for Air) and cited advantages to the existing arrangements. First, according to the subcommittee, the cognizance controversy and the parallel tracks in missile projects "have been stimulating and productive in the rapid development of a new scientific and technical field."[116] Moreover, duplication had been minimal and was, in any case, necessary "if national or service superiority is to be attained."[117]

Whatever the presumed advantages of the Navy's decentralized and fragmented acquisition organization, others saw weaknesses. In mid-1950, a board appointed by the chief of naval operations to survey the Navy's research and development program highlighted the diffusion of responsibility for coordinating R&D. Noting that this structure had grown up over time, the board expressed uncertainty "as to where a continuation of an unplanned evolutionary process may lead."[118] About the same time that the board was issuing its report, a group of 30 leading scientists, brought together under the auspices of the Office of Naval Research and the Massachusetts Institute of Technology (Project Hartwell) to make recommendations to guide research and development in the area of antisubmarine warfare, highlighted another problem stemming from decentralization. In its report, the Hartwell group urged the Navy to adopt the systems approach in weapons development but noted organizational obstacles: "The present bureau organization of the Navy includes no bureau concerned with the engineering of systems of which such items as ships or airplanes are components. The emphasis is on components, perfection of which does not assure excellence of systems."[119] Several months later, a team of naval officers and scientists, assigned to explore the need for a "systems coordinating facility," concluded that the consequence of the absence of such an agency was that "Often the fleet is left with the task of making all components of a system work together."[120]

Despite calls for greater centralization in aspects of its organization for acquisition, the Navy remained wedded to a decentralized and fragmented structure through the end of the Korean War. Some of the resistance to change may be seen as the normal behavior of institutions when traditional prerogatives are threatened, especially long-established organizations such as the technical bureaus. But, in the case of the Navy, such an explanation is not sufficient. Decentralization was deeply embedded in the Navy's culture. Some scholars locate its origins in the time before electronic communications when "a 'ship over the horizon' was a world unto itself, with its captain absolutely responsible for every soul and consequence that fell under his command."[121] The autonomy exercised by the captain at sea translated easily into an institutional commitment to decentralization that permeated the Navy's organization and activities, including acquisition. This legacy of autonomy may also have undergirded the Navy's opposition to the War Department's unification scheme and the later trend toward centralizing more power in the Office of the Secretary of Defense.[122]

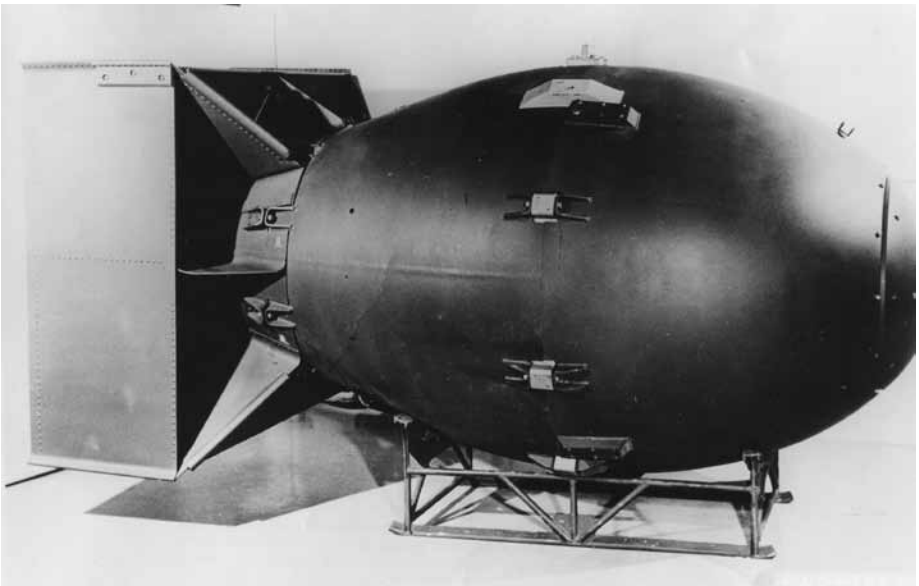
But after the Korean War, when given the opportunity to develop a sea-based intermediate range ballistic missile (the Polaris), a complex weapon system that required an extraordinary degree of subsystem integration, the Navy lacked confidence in the bureaus, the pillars of its decentralized acquisition structure, and established instead a highly centralized organization to develop the system, the Special Projects Office (see chap. 10).

ACQUISITION OF A NUCLEAR WEAPONS DELIVERY CAPABILITY

The Navy's development of a capability to deliver nuclear weapons is illustrative of the service's acquisition process. The case study has been chosen for two reasons. First, spurred by the conflicts over unification of the armed forces and over service roles and missions that followed the war, the ability to conduct nuclear attacks became increasingly important to the Navy; by early 1948, it was one of the service's highest priorities.[123] Second, the three major elements of this capability—the bombs, the planes, and the aircraft carriers—comprised a "system of systems." Considering the three together reveals how the characteristics of one system impacted the acquisition of other systems in the larger "system of systems." Many of the Navy's aircraft types and all of its attack carrier classes, built or building, were nuclear weapons-capable by the end of the Korean War. This section will cover in detail the acquisition of two of these systems—a heavy attack aircraft, the AJ–1, and an aircraft carrier that never sailed, USS *United States*.

The Bombs

Nuclear weapons were designed, developed, and produced, not by the services, but by the Atomic Energy Commission in its laboratories in Albuquerque and Los Alamos, New Mexico, and Livermore, California. Two features of those weapons significantly affected the Navy's acquisition of a nuclear weapons delivery capability—the bombs were big and the amount of fissionable material to make them was limited. Both types of atomic bombs used against Japan were huge. The "gun-type" *Little Boy* that was dropped on Hiroshima on 6 August 1945 weighed almost 9,000 lbs., and was 10½ feet in length and 2 feet in diameter.[124] The teardrop-shaped, implosion-type *Fat Man* that exploded over Nagasaki on 9 August 1945 weighed more than 10,000 lbs. It was only 2 inches longer than *Little Boy* but, at 5 feet, was much larger in diameter.[125] In the summer of 1945, the only aircraft able to carry either device was the Army Air Forces' four-engine bomber, the B–29. The maximum bomb load of any of the Navy's carrier-based aircraft at the time was 2,000 lbs. Given this payload limitation, the Navy would need to develop not only much larger and more powerful aircraft but also aircraft carriers able to accommodate the bigger and heavier planes.



A nuclear weapon of the "Fat Man" type that was dropped on Nagasaki, Japan, on 9 August 1945. The most common atomic bomb in the U.S. arsenal for several years following World War II, it was 5 feet in diameter, over 10 feet long, and weighed about 10,000 pounds.
Courtesy, Special Collections, U.S. Air Force Academy Library.

Until 1952, the Mark III production model of the original *Fat Man* and its descendants, the Mark 4 and the Mark 6, were the standard atomic bombs in the U.S. stockpile. All weighed between 8,500 and 10,800 lbs., were 5 feet in diameter, and 10⅔ feet in length.[126] Nuclear scientists had been studying the possibility of much lighter and smaller atomic bombs since 1946. The Navy had advocated their development, but serious attempts to design and fabricate such weapons did not begin until 1949. The delay stemmed primarily from Air Force opposition to diverting scarce fissionable materials from the production of the large, high-yield weapons intended for the strategic air offensive.[127]

Expansion of the supply of fissionable material in the late 1940s opened the door to more rapid development of substantially lighter and smaller devices that came to be called tactical nuclear weapons. Several entered the inventory in 1952. The Mark 7, an implosion bomb, weighed about 1,700 lbs. and measured 15¼ feet in length and 2½ feet in diameter. The gun-type Mark 8 weighed approximately 3,200 lbs., but was only about 10 feet long and 1¼ feet in diameter. It was designed to be a penetrating weapon, with delayed detonation suitable for use against fortified or buried targets not easily damaged by air or surface-burst implosion bombs.[128]

The reduction in the physical dimensions of nuclear weapons had a significant impact on naval aviation and on the Navy's place in the national defense structure. Early in 1949, in anticipation of size and weight reductions, the chief of naval operations instructed the Bureau of Aeronautics to configure aircraft then in the design stage and expected to be available in 1952 to carry only the smaller nuclear weapons.[129] When the Mark 7 and the Mark 8 were added to the nuclear stockpile in 1952, several carrier-based tactical aircraft could carry them externally.[130] Combined with the increased availability of fissionable materials, the appearance of tactical nuclear weapons greatly enlarged the Navy's nuclear strike role.[131]

The Planes

Scarcely three weeks after the atomic bomb was dropped on Hiroshima, and without any instruction from OPNAV, the Bureau of Aeronautics began planning for an aircraft that could deliver the new weapon. The bureau's revised budget estimate for experimental aircraft for FY 1946, dated 28 August 1945, stated: "Carrier aircraft will for a period of years be the only agency capable of delivering the atomic bomb to every part of the world. Full realization of this potentiality will require the development of at least one new aircraft prototype . . . .[132] To meet the need, the bureau programmed $10 million of the nearly $76 million it planned to spend on experimental aircraft that year.[133] The eventual outcome of this initiative was the North American AJ–1 Savage, the first Navy aircraft developed specifically for the nuclear attack role. The history of its acquisition demonstrates the problems that often arise when weapon system programs are accelerated and key phases are either carried out concurrently or severely truncated.

The advent of the atomic bomb notwithstanding, the Bureau of Aeronautics had been planning since the spring of 1945 to acquire carrier-based, heavy attack planes with payloads several times those of the Navy's wartime bombers.[134] By the end of the year, it was ready to go forward with a heavy attack program. In an 11 December 1945 memorandum to the chief of naval operations, the bureau's chief, Rear Adm. Harold B. Sallada, noted that it would be possible to develop three classes of turboprop-driven, heavy attack aircraft.[135] The first, weighing 30,000 lbs. fully loaded, would be able to operate from the three *Midway*-class carriers, the Navy's largest and most recently commissioned class of fleet carrier; the second, at 45,000 lbs. would also be able to operate from the *Midway* carriers but with certain restrictions; the third, at 100,000 lbs. would require construction of an entirely new and larger class of aircraft carrier.[136] Each class of heavy attack, turboprop aircraft would be able to carry an 8,000 to 12,000-lb. bomb load, but the larger the aircraft, the greater the combat radius. The 45,000-lb. turboprop, with an 8,000-lb. payload, for example, would be able to operate at 35,000 feet, attain a top speed of 434 knots (500 mph), and have a 1,000 nm combat radius. A larger bomb load would reduce the turboprop's combat radius commensurably.[137]

AJ–1 Savage at Naval Air Station, Patuxent River, Maryland, March 1951.
Courtesy, Naval History and Heritage Command.

To achieve a carrier-based, long-range attack capability, Admiral Sallada proposed a four-part program. First, because turboprop technology was not yet sufficiently advanced, Sallada wanted approval to acquire an aircraft in the 45,000-lb. class employing a combination of turbojet and piston engines. This plane's performance characteristics with an 8,000-lb. payload would be similar to those projected for a turboprop aircraft in the same weight class, except that its combat radius would drop from 1,000 to 300 nm. The aircraft, combining a turbojet and two piston engines, would also be able to carry a 12,000-lb. payload but "at a very great" additional reduction in speed and range. For the second part of the program, Admiral Sallada recommended that the Bureau of Aeronautics pursue development of a turboprop aircraft in the 45,000-lb. class when the technology had progressed adequately.[138] Third, he suggested that the Navy should begin to design and develop both an aircraft in the 100,000-lb. class and an aircraft carrier that could accommodate a plane of that size. The fourth part of the program would be to acquire escort fighters that could accompany the long-range bombers. Admiral Sallada did not mention the atomic bomb in his memorandum. On 28 December 1945, the chief of naval operations approved three of Sallada's recommendations, giving them high priority but deferring a decision on the proposal for a coordinated effort to develop a 100,000 lb. aircraft and new aircraft carrier.[139]

After receiving the CNO's approval, and with money already set aside to fund the first part of the heavy attack program, the Bureau of Aeronautics moved rapidly. On 25 January 1946, the bureau sent letters to 12 aircraft manufacturers requesting design and cost proposals for an aircraft in the 45,000-lb. class powered with both turbojet and piston engines and suitable for restricted operation from *Midway*-class carriers. Its desired performance characteristics were the same as those Admiral Sallada had specified for a heavy attack aircraft of that type in his memorandum to the chief of naval operations. The Bureau of Aeronautics also included additional specifications: the aircraft's bomb bay should be 5 feet in diameter and 16 feet long—a compartment large enough for either the Little Boy or Fat Man–type bombs.[140]

As originally conceived, the turbojet/piston-engine plane was to be a "demonstration project" designed to prove that operating such heavy aircraft from carriers was feasible. Thus, initially, the bureau was not particularly concerned that its combat radius would be only 300 nm. Moreover, as George Spangenberg (an aeronautical engineer who had begun working at the Bureau of Aeronautics in 1939 and who, by the late 1950s, had become head of the division that evaluated contractor proposals for new aircraft) recalls: the proposed follow-on turboprop aircraft (the XA2–J) "was supposed to have enough performance . . . to do the nuclear attack job."[141]

Only three manufacturers—Consolidated-Vultee (Convair), Douglas, and North American—responded to BuAer's request for proposals. Following an internal evaluation, the bureau selected the North American entry because it came closest to meeting the maximum weight permissible for landing on the *Midway*-class carriers (29,000 lbs.) and offered the lowest cost estimate.[142] On 24 June 1946 the Bureau of Aeronautics, by letter of intent, awarded a fixed-price-incentive contract for just over $12 million to North American to provide three prototypes for flight test (the X, or experimental models) and one airframe for static tests.[143] This aircraft, with a piston engine mounted in a nacelle under each wing and with a single turbojet in the aft fuselage, was designated the XAJ–1. Its operating altitude would be 35,000 feet, its top speed 434 knots (500 mph), its combat radius 700 nm (with the addition of wingtip tanks), and its payload 10,000 lbs.[144]

At what time the atomic bomb's dimensions began to influence the aircraft's design remains a question mark. One authority maintains that the AJ–1 was intended to carry the bomb from the time the Bureau of Aeronautics called for proposals from the aircraft manufacturers early in 1946.[145] Another argues that the plane was not originally designed around the bomb and was reconfigured for it only in late 1946.[146] Some writers simply are unsure.[147] Previously unused sources suggest that the Bureau of Aeronautics planned to develop a nuclear weapons–capable bomber as early as August 1945, budgeted money for the aircraft, and, despite the extreme secrecy surrounding atomic energy, possessed enough information about the sizes and weights of the atomic bombs to go ahead with a request for design proposals with specifications closely approximating their dimensions. Sometime in the fall of 1946, Cdr. Frederick L. Ashworth, who had been the weaponeer on the Nagasaki mission and who was then assigned to the Special Weapons Division (Op–06) in OPNAV, and Capt. J. N. Murphy, director of the Armament Division in the Bureau of Aeronautics, visited North American's plant in Inglewood, California, where the XAJ–1 was being built. Ashworth provided the contractor detailed guidance concerning the installation of the Fat Man–type bomb. But this information was neither the bureau's nor North American's first indication of the weapon's dimensions: both were already aware of its approximate physical characteristics.[148]

Early in the fall of 1947, the Navy accelerated the AJ–1 program by overlapping development and production. Although the XAJ–1 would not make its first flight until July 1948, the Bureau of Aeronautics let fixed-price-incentive contracts to North American for 12 aircraft in September 1947 and for an additional 28 in May 1948.[149] Awarding production contracts prior to an experimental aircraft's first flight was a departure from the bureau's well-established sequential procedure for acquiring new aircraft. According to this practice, an aircraft's first flight would be followed by a series of evaluations conducted by BuAer. The contractor would then correct any deficiencies that surfaced during the trials. Only after the necessary modifications had been completed would the bureau normally award a production contract.[150]

In addition to introducing concurrent development and production, the Navy further accelerated the AJ–1's acquisition by compressing the aircraft's flight-test program. Standard practice was for initial production models of an aircraft to be thoroughly tested at the Naval Air Test Facility at Patuxent River, Maryland, prior to assignment to an operational unit. The first flight of a production AJ–1 took place in May 1949 and flight-testing began at Patuxent River. In September, just four months later and before the test program was completed, the first AJ–1 entered fleet service with Composite Squadron 5 (VC–5), which was commanded by Cdr. John T. Hayward and was located at Moffett Field Naval Air Station, California. In order to achieve operational readiness as quickly as possible, the remainder of the AJ–1's flight-test program would be carried out concurrently by regular test pilots at Patuxent River and by VC–5 pilots at Moffett Field.[151] Commander Ashworth, second in command of VC–5 and later the first commanding officer of VC–6, the Navy's second nuclear weapons–equipped, heavy attack squadron when it was commissioned in January 1950, was not enthusiastic about accelerating the AJ–1's test program. When he assumed command of VC–6, Ashworth recommended to Hayward that the aircraft be withdrawn from fleet service until testing had been completed at Patuxent River. Hayward rejected the recommendation.[152]

Throughout its development and service with the fleet, the AJ–1 experienced numerous difficulties. The advanced bombing and navigation system intended for the AJ–1 was not ready when the plane entered service, forcing the employment of an older, less capable system for several years. But the most significant problems involved the aircraft's hydraulic, flight control, and fuel systems; its turbo superchargers; and the jet engine installation. Deficiencies in these subsystems led to numerous crashes and lives lost.[153] Some accidents, not unexpectedly, occurred during the AJ–1's development and early operational service. But the plane's safety record did not improve with the passing years. The AJ–1, its follow-on, the AJ–2, and a photographic reconnaissance version, the AJ2–P, were involved in 35 major accidents that cost the lives of 16 crewmembers between 1952 and 1958.[154] To some in the Navy, the aircraft was known as "Pride's Folly," after Rear Adm. Alfred M. Pride, chief of the Bureau of Aeronautics during most of the period of the plane's development and production.[155]

William E. Scarborough, a retired naval officer who studied the AJ–1's history and flew the plane during his active service, attributed the aircraft's troubles to two factors: first, an inadequate design that resulted from sharp reductions in North American's engineering staff following World War II, and second, and most important, compression of the normal sequential development and testing cycle. Scarborough does not question the Navy's need for the long-range, nuclear-attack capability represented by the AJ–1. But he states clearly that acceleration of the program came at a price: "Design deficiencies which surfaced during test and early operational flying were the source of accidents causing the loss of aircraft and a number of fatalities. . . . Many of the problems undoubtedly would have been detected and corrected during the early stages of a normal contractor flight test program."[156]

Determining precisely when the AJ–1 gave the Navy a nuclear weapons delivery capability is like identifying beauty—it's in the eye of the beholder. On 21 April 1950 the plane made its first carrier takeoff, and on 31 August 1950, its first carrier landing. But the Savages were grounded for much of the time from late 1950 through late 1951 as a result of aircraft accidents and completion of modifications necessary to correct the aircraft's deficiencies.[157] In any case, the distinction of giving the Navy its initial nuclear weapons delivery capability belongs to an aircraft never intended for the role, the Lockheed P2V Neptune.

Early in 1948, with the XAJ–1 Savage still half a year from its first flight, the Navy began to modify several of its land-based, long-range, twin piston-engine P2V patrol bombers to operate from the three *Midway*-class carriers with a nuclear payload (the aircraft's bomb bay could accommodate only the Little Boy–type weapon). When reconfigured and fully loaded, the 74,000-lb. Neptune, redesignated the P2V–3C, could take off from a *Midway*-class carrier assisted by JATO (jet-assisted take off) rockets. Even so, on takeoff, its starboard wingtip would come within a few feet of the ship's island superstructure. The Navy also considered the plane to be too heavy to risk landing on the carrier. On 7 March 1949, a P2V–3C piloted by Commander Hayward made a JATO launch from *Coral Sea*, then off the Virginia coast. Carrying a simulated 10,000-lb. bomb load on a flight lasting 23 hours, the aircraft flew 2,000 miles to Muroc, California (soon to become Edwards Air Force Base), dropped the simulated weapon, and returned 2,000 miles across the continent to land at Patuxent River.[158] Theoretically, at least, the Navy now possessed a carrier-based, nuclear weapons delivery capability.[159]

THE SECDEF TAKES OFF FROM AN AIRCRAFT CARRIER

On 26 September 1949, about 100 miles off the East Coast, a P2V–3C Neptune, configured to carry an atomic bomb, sat poised for take off from the aircraft carrier *Midway* for a flight to Washington, D.C. Piloted by Cdr. John T. ("Chick") Hayward, commanding officer of VC–5, the first Navy nuclear weapons–capable aircraft squadron, the plane carried some important passengers, including Secretary of Defense Louis Johnson, Secretary of the Air Force Stuart Symington, Chairman of the Joint Chiefs of Staff General Omar Bradley, and Army Chief of Staff General J. Lawton Collins. They had been on board the carrier to observe a naval firepower demonstration.

Secretary Johnson's visit to *Midway* must have been tense. Five months earlier, on 23 April 1949, he had abruptly cancelled the flush-deck supercarrier *United States*, just five days after the ship's keel had been laid. The Navy wanted the giant ship, designed without an island superstructure, to accommodate the large aircraft needed to carry the big and heavy atomic bombs then in the inventory over long distances. Angered by Johnson's action, taken without consulting the service's top leadership, Secretary of the Navy John L. Sullivan sent President Truman a strongly worded letter of resignation on 26 April. A month later, Sullivan and Under Secretary W. John Kenney, who resigned as a gesture of solidarity with his boss, left their posts in the Navy Department.

As the Neptune's engines warmed up, Hayward recalls that he told Johnson: "Mr. Secretary, our wingtip will clear the island by only about six feet . . . so if our right-side engine conks out, the Navy will have a flush-deck carrier whether you want it or not. . . ." Then, according to Hayward, "we roared down the deck, Johnson white-knuckled, squeezing his seat arms as we lifted off." [I]

P2V–3C Neptune, with Secretary of Defense Johnson on board, in rocket-assisted take off from the carrier USS *Midway* (CVB–41), 26 September 1949. Note proximity of the aircraft's right wingtip to the ship's island superstructure.
Courtesy, Naval History and Heritage Command.

At best, however, the Neptunes provided only a minimal nuclear capability. With a maximum speed of 275 knots (317 mph) when carrying an atomic bomb, it is doubtful that a P2V–3C would ever have reached a target defended even by World War II-era Soviet fighters, let alone the MiG–15 jets that flew in excess of 587 knots (675 mph) and had entered service in 1949.[160] With a top speed of 434 knots (500 mph), the AJ–1 was more survivable. But because of their weights and sizes, neither the Savages nor the Neptunes were well suited to operate from the carriers in commission in the late 1940s and early 1950s.

The Carriers

In the fall of 1947, in a letter to Secretary of the Navy Sullivan, Rear Adm. Thomas S. Combs, an assistant chief of the Bureau of Aeronautics, presented justification for including a new flush-deck carrier in the Navy's Shipbuilding and Conversion Program for FY 1949. Such a vessel, then identified as Project 6A, was needed, according to Combs, to operate "aircraft of advanced size and weight" that would be capable of conducting long-range strikes with atomic bombs. He pointed out that although the three *Midway*-class carriers were being modified to accept the AJ–1, then under development, the aircraft would still tax these large carriers "to the utmost." Moreover, to allow for the dimensions of these ships, the plane's design had been "forced to suffer considerably," particularly by imposing limitations on its range. "If we are to be capable of carrying this [the atomic] bomb to more effective distances," concluded Combs, "it will have to be done by a larger aircraft, which cannot be operated from the CVB [designation of the *Midway*-class carriers]. Thus, a new design is dictated, namely Project 6A."[161] Sullivan agreed that "the building of such a ship is essential to the maintenance of our sea-going airpower."[162] Following President Truman's approval of the Navy's FY 1949 ship program in December 1947 and the appropriation of funds by Congress in June 1948, the Navy designated the ship CVA–58. In March 1949, the president approved the Navy's recommendation to name it *United States*. But on 23 April 1949, Secretary of Defense Johnson, less than a month after assuming his post and only five days after the ship's keel had been laid, summarily cancelled the "supercarrier." *United States* was never finished, but its history illustrates the process by which the Navy acquired a major combatant and highlights the weaknesses in an acquisition structure based on the bureau system.

The Navy had begun planning for a fleet carrier to succeed the *Midway* and *Essex*-class carriers in the spring of 1945, but those design studies did not envision a large, flush-deck vessel. Work on the design for the ship that became *United States* started in 1946 and was an outgrowth of Rear Adm. Sallada's 11 December 1945 recommendation to the chief of naval operations that a coordinated effort be undertaken to design and develop a 100,000-lb. heavy attack aircraft and suitably sized carrier from which to launch it. As noted previously, the CNO initially deferred a decision on the BuAer chief's suggestion. But in January 1946, following strong endorsement of the carrier by Vice Adm. Marc A. Mitscher, the deputy chief of naval operations for air, the CNO forwarded the proposal to Sullivan, then assistant secretary of the Navy for air, who approved the initiation of design studies for both plane and carrier.[163]

Neither the new plane nor the new carrier would be ready for five years or more. What was destined to be the nuclear weapons–capable AJ–1, however, was expected be available much sooner. To accommodate an aircraft of this size and weight and the atomic bombs that the Savages would carry, the three *Midway*-class carriers would have to be modified. In November 1946, the chief of naval operations approved a program that included strengthening their flight decks, adding larger bomb elevators, and providing special facilities on board the ships to stow and handle the nuclear weapons.[164] By the fall of 1947, the modifications had been made to the just-commissioned *Coral Sea* and, by the end of 1948, would be completed on both *Franklin D. Roosevelt* and *Midway*.[165] Modification of the three carriers had received first priority, but in June 1947 the CNO authorized a similar but more extensive conversion program for the more numerous, but smaller, *Essex*-class carriers. Modernization of *Oriskany*, the first of the nine *Essex* to be converted under this program, began in October 1947 and was completed in September 1950.[166]

By the time the Navy authorized modifications for the *Midway*-class carriers in late 1946, the Ship Characteristics Board and the Bureau of Ships had made considerable progress on the design for the new large carrier. Early in 1947, the board identified characteristics for the ship. In mid-1947, it submitted a proposed Shipbuilding and Conversion Program for FY 1949 to the chief of naval operations that included the carrier as priority two. The CNO, in turn, sent the board's recommendations for the FY 1949 ship program to the General Board that, while approving the carrier, accorded it a lower priority. In what was perhaps an indication of the General Board's declining influence, the CNO accepted the priority for the carrier recommended by the Ship Characteristics Board and, early in September 1947, forwarded the ship program to Acting Secretary of the Navy Kenney, who approved it immediately.[167]

The new carrier had successfully negotiated the Navy's internal acquisition hurdles, but the barriers standing in the ship's way outside the service were more formidable. President Truman's budget director, James Webb, balked at the projected costs of the FY 1949 shipbuilding program. To obtain the Bureau of the Budget's approval to include the carrier, the Navy had to agree to halt construction already under way on several other vessels. Following this concession, the president approved the Navy's shipbuilding program in December 1947. Then, in May 1948, with the Air Force alone dissenting, the Joint Chiefs of Staff formally sanctioned the carrier's construction. In June, Congress appropriated the initial funding.[168]

The characteristics originally proposed for the Project 6A carrier went through several revisions. In November 1948, the chief of naval operations approved the final version.[169] *United States* would be a flush-deck design, 1,030 feet in length and 130 feet in beam at the waterline, and with a standard displacement of 65,000 tons.[170] The carrier was to be capable of operating an air group consisting of 18 heavy attack aircraft and 50 fighter aircraft with landing weights of 100,000 and 20,000 lbs. respectively. Its other aviation features would include a hangar deck with a clearance of not less than 28 feet, 4 elevators able to transfer the attack aircraft (with wings and tail folded) between the hangar and flight decks, 4 bomb elevators servicing the flight deck each able to lift 16,000 lbs., 3 catapults, and storage capacity for 500,000 gallons of aviation fuel that could be pumped at the rate of 150 gallons per minute at each fueling station.[171]

The ship's most prominent feature was the flush-deck design. Unlike most aircraft carriers of the time, no "island" superstructure would project above *United States'* flight deck. All radar, radio, ship, gunnery, and air control stations would be located below flight-deck level; if required to function above the flight deck, they would have to be able to retract rapidly. The flush deck had distinct advantages: aircraft wingspan would not be a limiting factor and all-weather flight operations would be facilitated. But the design presented new problems, not yet resolved when the chief of naval operations approved the ship's characteristics. These included the location of the ship's control stations, provision for using information relayed to the carrier from radar and other equipment on board other ships or aircraft, and a method for dispersing flue gases.[172] Solving the latter problem was critical because smoke and gases at flight-deck level would interfere with flight operations.[173]

Artist's conception of USS *United States* (Bruno Figallo, October 1948).
Courtesy, Naval History and Heritage Command.

In addition to the advantages offered by the flush-deck arrangement, the new carrier's design would address other obstacles to operating heavy attack aircraft of increasing size. The dimensions of the aircraft elevators and hangar decks in the *Midway* and *Essex*-class carriers limited the size of aircraft that could be handled below the flight deck. Their inability to transfer heavy attack aircraft from the flight deck to the hangar deck significantly reduced the number of such planes that could be maintained on board the carriers and also complicated aircraft launch and recovery operations.[174] The CVA–58's aircraft elevators would be larger than those on the existing carriers, and its increased hangar deck clearance (28 feet as opposed to the 17½ feet on the *Essex* and *Midway*-class carriers) could accommodate heavy attack aircraft with wings folded vertically.[175]

Keel plate laid for USS *United State*s (CVA–58) at the Newport News Shipbuilding and Dry Dock Company shipyard, Newport News, Virginia, 18 April 1949. Five days later, on 23 April, Secretary of Defense Johnson cancelled the carrier.
Courtesy, Naval History and Heritage Command.

In July 1948, President Truman approved the Navy's request to have the flush-deck carrier constructed in a private rather than a government-owned shipyard.[176] (The Vinson-Trammel Act of 1934 required half of the Navy's ships to be built in government shipyards.[177]) Newport News Shipbuilding and Dry Dock Company of Newport News, Virginia, was awarded a sole-source contract to build the ship.[178] It was estimated to cost $124 million, not including funds for its air group, with completion expected in 1952.[179] The carrier could have been built in three of the Navy's own shipyards (and some improvements were required in the Newport News facility before construction could begin), but the private firm was probably chosen for several reasons.[180] First, the company was the Navy's premier aircraft carrier manufacturer. It had designed both the *Essex* and *Midway*-class carriers; it had built 8 of the 24 *Essex*-class carriers that were ultimately produced and 2 of the 3 CVBs (*Midway* and *Coral Sea*).[181] Second, its design staff had provided the detailed plans for the ships in those two classes constructed in other yards and the plans for modifying the 3 *Midway*-class carriers.[182] Finally, Navy policy after World War II was to place a considerable portion of the limited funds available for new construction and conversion with private yards "to help keep the industry alive, particularly its design staffs, until an increase in merchant construction materializes."[183]

Similar to the aircraft manufacturers, shipbuilders had experienced a period of decline following the cancellation of wartime contracts and sharply reduced postwar military budgets. Newport News was no exception. In 1946, the company's workforce had dropped from the wartime high of 35,000 to just over 11,000. In the 18 months from mid-1945 to the end of 1946, the company's only new construction contracts were for three fruit ships and two tugboats.[184] In March 1947, after the launching of the heavy cruiser *Newport News*, the company did not have a ship under construction or a contract to build any.[185] The contract for *United States* promised a brighter future for the Virginia shipyard.

Following the contract award, the most pressing task facing Newport News and the Bureau of Ships was to prepare the detailed "contract plans" that would guide the ship's construction. This was an enormous undertaking, since the plans were estimated to require 200 tons of blueprint paper.[186] Both Newport News and the Bureau of Ships participated in drawing up the contract plans, with the bureau approving those completed by the contractor. The extent of the bureau's involvement in preparing the contract plans reflected the much greater role it played in ship system design compared to that of the Bureau of Aeronautics with respect to aircraft. Although the Bureau of Aeronautics sometimes accomplished preliminary designs for new planes, detailed design work and subsequent development were performed by the contractor and evaluated by the bureau.[187] Both bureaus monitored the contractor's progress with representatives located on site. The Bureau of Aeronautics representative, the BAR, was an officer assigned to duty at the aircraft manufacturer's plant; the Supervisor of Shipbuilding, the SupShips, performed the same function at the shipyard for the Bureau of Ships. Assisted by a staff of naval engineers and inspectors, the SupShips acted as liaison between the bureau and the contractor and possessed some authority to approve design changes suggested by the latter.[188]

The Navy's desire for the flush-deck carrier to be completed as rapidly as possible created tensions with the shipbuilder. Early in March 1949, within weeks of the scheduled keel-laying, Newport News' executive vice president and general manager, William E. Blewett, Jr., voiced several complaints to an officer visiting the yard from the Bureau of Ships. His principal concern was that decisions on key issues affecting the ship's design, such as those involving the arresting gear, catapults, and the location of the ship's guns, had not yet been made. Without these determinations, contract plans could not be completed and the tight construction schedule would be endangered. Blewett was also critical of the bureau's failure to act promptly on plans that the company had previously prepared for the carrier and on bids for subsystems that Newport News had submitted from its subcontractors.[189]

In response to the complaints, the officer from the Bureau of Ships recommended that additional personnel be added to the bureau's design division and that greater use of overtime be made in the shipyard and in the bureau.[190] But such measures did not address a more fundamental problem. The principal reason that decisions regarding the ship's major subsystems had been delayed was that no single agency possessed the authority to integrate those systems. The Bureau of Ships had the primary responsibility for the carrier, but depended on the Bureau of Ordnance for armament and on the Bureau of Aeronautics for aircraft and aviation support systems such as catapults, arresting gear, and barriers. Each bureau naturally viewed the vessel from its particular perspective. OPNAV arbitrated among the three bureaus to resolve disagreements, but its involvement, while eventually producing decisions, also increased delays. As was true with *United States*, in the Navy's decentralized and fragmented acquisition structure the absence of an overarching authority to effect integration of subsystems provided by different bureaus, often hindered the service's ability to deliver the most advanced weapon systems to the fleet rapidly.

As noted previously, the cancellation of *United States* in April 1949 set back the acquisition of a new fleet carrier from 1952, the year projected for CVA–58's completion, to 1955, when CVA–59, *Forrestal* was commissioned. At the same time, the loss of the new carrier forced the Navy to redesign the heavy attack aircraft in the 100,000-lb. class being planned for *United States* to conform to the operating limitations of the *Midway*-class carriers, particularly with respect to landing weight.[191] Among the competitors for the contract to build the 100,000-lb. aircraft, Douglas Aircraft's jet-powered, swept-wing entry most nearly met these requirements and was selected for development and subsequent production.[192] Designated the XA3D–1, the aircraft first flew in October 1952 and entered fleet service in March 1956. Fully loaded, the A3D Skywarrior weighed approximately 70,000 lbs.[193] Until the A3D's acquisition, the AJ–1 filled the heavy attack role. By the mid-1950s, the adoption of the angled deck made carrier operations with heavy attack aircraft much easier. But, at the same time, the availability of more compact nuclear weapons had lessened the need for, but not the utility of, a large carrier-based, heavy attack aircraft.

Some scholars have suggested that the Navy did not aggressively seek a nuclear-strike capability immediately after World War II. Only a small group of officers operating outside established organizational channels had pursued this goal.[194] By mid-1946, however, the Navy's leadership had begun to move in this direction. In July, Navy officials, wrongly believing that they lacked the necessary authority, sought and obtained President Truman's permission to prepare and equip naval forces to conduct nuclear warfare.[195] Additionally, before the end of the year, as we have seen, the chief of naval operations authorized a modification program that would enable the three *Midway*-class carriers to launch nuclear strikes. Yet, focusing on top-level activity somewhat obscures the nature of the service's acquisition process. In the Navy during this period, the locus of acquisition was in the bureaus. Traditionally, they had enjoyed wide latitude, if not virtual independence, in developing and procuring the Navy's weapon systems.

When the Bureau of Aeronautics took the first step toward acquiring a nuclear weapons–capable aircraft in August 1945, its action was entirely consistent with the decentralized nature of the Navy's acquisition structure. Indeed, by seizing the initiative, the bureau quite likely advanced the AJ–1's availability—and the Navy's nuclear weapons delivery capability—by half a year or more.

THE MARINE CORPS AND ACQUISITION: THE AMTRACS

For the half century from World War II through the Iraq wars, no major weapon system symbolized the Marine Corps more than the amphibious tractor—the amtrac.[196] Developed during World War II, the amtrac, or LVT (landing vehicle, tracked), was most well known for transporting troops from larger vessels standing offshore to the beaches during the assaults on the Pacific islands.[197] LVTs differed from other amphibians, such as the DUKW, in that their tracks enabled them to traverse coral reefs or other obstacles.[198] After the war, several prototypes of new vehicles to replace the wartime designs were developed, but none had entered production by the outbreak of the Korean War. In the fall of 1950, the Navy undertook a crash program to field two new systems, an armored personnel carrier, the LVTP–5, and a howitzer-equipped, fire support amtrac, the LVTH–6.[199] Measured by longevity—both were still in service in Vietnam in the 1970s—the two vehicles constituted a successful acquisition program. But as with sausage, a close look at the preparation process reveals a much different picture. The procurement of the two LVTs was beset with problems that reflected both the pitfalls—schedule slips, performance shortfalls, and cost increases—associated with pursuing development and production concurrently, and the weaknesses of the Navy's decentralized and fragmented acquisition structure.

Between 1945 and 1950, the Marine Corps struggled to maintain the capability to conduct amphibious warfare. Many believed that the atomic bomb marked the end of the large-scale amphibious landings characteristic of World War II. Even so, JCS war plans called for Marine forces to engage in amphibious operations to seize oilfields in the Middle East and to retake the European continent if overrun by Soviet forces. Within the Marine Corps, some hoped to exploit the new technology of the helicopter to reduce the vulnerability of landing forces. But through the Korean War, advocates of what came to be called "vertical envelopment" were in the minority; majority opinion favored the development of more capable landing craft and changes in amphibious assault tactics. The Marines wanted faster, more heavily armed vehicles that could be more widely dispersed as they approached the shore and could accompany forces advancing inland.[200]

LVTP–5 at Camp Pendleton, California, 1958.
Courtesy, *Leatherneck Magazine*; photo by Marine TSgt Charles B. Tyler.

Despite the need for better vehicles, sharply reduced postwar military budgets and the lower priority accorded amphibious warfare in the Navy permitted only research and development projects; there was not enough money to buy new vehicles. By the summer of 1950, work was then in progress on a "family" of 10 new vehicles, including several personnel and cargo carriers and howitzer-equipped LVTs.[201] But, for the immediate future, no series production was expected.

Prevented from buying new vehicles, the Marine Corps secured approval for a modernization program for its most advanced World War II designs, an armored personnel carrier, the LVT–3, and fire support vehicles armed with 75-mm. howitzers, the LVT(A)4 and LVT(A)5.[202] Modification of these systems, totaling more than 1,400 vehicles, began in 1949 and was completed in 1953.[203] The principal improvements to the LVT–3, designated the LVT–3C after modification, centered on troop protection: a cover for the cargo compartment, escape hatches, side armor plate, and a .30-caliber machine gun turret. Modifications to the howitzer-equipped amtracs were less extensive.[204] The Marine Corps employed both systems in the Korean War, primarily in operations on land rather than over water.[205] But when the war started, the Marine Corps did not believe that any of the modernized LVTs or any of the amtracs then under development possessed the capabilities essential for amphibious warfare in the future. Consequently, in September 1950, the Navy launched a crash program to develop and manufacture entirely new designs, the LVTP–5 and the LVTH–6.

LVTH–6 at Camp Pendleton, California, 1958.
Courtesy, *Leatherneck Magazine*; photo by Marine TSgt Charles B. Tyler.

Before examining this accelerated program, it is necessary to describe how the Marine Corps obtained a major weapon system during the 1940s and 1950s, especially the organizational relationships that influenced LVT acquisition. Throughout their history, the Marines largely depended on the other services or even foreign companies for materiel. After the Marine Corps established a requirement and the chief of naval operations approved it, the Army or Navy (usually the latter) developed and procured the system. Thus, for example, the Marines acquired tanks through the Army's Ordnance Department (Ordnance Corps beginning in 1950), planes through the Bureau of Aeronautics, and amphibious vehicles through the Bureau of Ships.[206]

Special organizational arrangements governed LVT acquisition. In 1943, the secretary of the Navy had established the Continuing Board for the Development of Landing Vehicles, Tracked. The board's job was to determine the military characteristics of new vehicles and to make recommendations to the chief of naval operations regarding LVT development programs. Marine officers sat on the board, but the senior member was from the Bureau of Ships.[207] Thus, even though the Marine Corps was the primary user, the Bureau of Ships controlled LVT development. Following action by the LVT Continuing Board, the bureau awarded development contracts. Procurement of new LVTs or modification of existing vehicles took place according to the previously described process by which the Navy formulated its annual shipbuilding and conversion program.

The National Security Act of 1947 opened the door to eventual Marine Corps control of LVT acquisition. The act charged the Marine Corps, in coordination with the other services, to develop "those phases of amphibious operations which pertain to the tactics, technique, and equipment employed by landing forces."[208] The Marine Corps did not attempt immediately to claim the new authority to develop landing-force equipment because so little was taking place with respect to LVT acquisition in the late 1940s.[209] But in 1950, as more money became available for amtracs, the Marines began to assume some of the authority granted under the law. In the spring, the chief of naval operations recommended to the secretary of the Navy that reports of the LVT Continuing Board be submitted first to the commandant of the Marine Corps and then to the CNO.[210] In the summer, the secretary of the Navy determined that the senior member of the board would come from the Marine Corps rather than the Bureau of Ships.[211] Finally, in the fall of 1950, the secretary of the Navy approved the commandant's request for the Marine Corps to fund LVT research, development, and procurement from its own budget beginning in FY 1952.[212]

Despite these changes, the Marine Corps still shared considerable responsibility for LVT acquisition with the Bureau of Ships. The bureau managed LVT development and procurement contracts. Additionally, as a "technical assistant" to the secretary of the Navy, it claimed "engineering cognizance" over LVT design and development. The bureau's assertion of this authority created conflict with the Marine Corps, which insisted that "tactical and operational" considerations should prevail over strictly "technical" concerns. In other words, as the user of the equipment, the Marines claimed the final say regarding design changes that might affect an LVT's military characteristics. The failure to reach agreement as to which changes were "operational and tactical" and which were "technical" handicapped the LVTP–5 and LVTH–6 acquisition programs.[213]

Following the North Korean attack in June 1950, the Truman administration launched its military buildup. Amphibious landing craft were part of the rearmament. At that time, the Marine Corps notified the Navy that even with the modernization of the World War II amtracs, the LVT inventory would still be several hundred vehicles short of requirements. Rather than increase production of the older, modified LVTs, or produce the prototypes then being developed, the Marines favored acquiring completely new vehicles.[214] On 26 September 1950, barely 10 days after the Inchon landing, the LVT Continuing Board approved the military characteristics for what became the LVTP–5 personnel carrier and the LVTH–6 fire support vehicle. The board also recommended that development and production take place concurrently.[215]

On 11 December 1950, via letters of intent, the Bureau of Ships awarded contracts to produce the new amtracs to four companies, all with previous experience manufacturing LVTs: Ingersoll Products Division of Borg-Warner

Corporation, Kalamazoo, Michigan; Baldwin-Lima-Hamilton Corporation, Lima, Ohio; Food Machinery and Chemical Corporation, San Jose, California; and Pacific Car and Foundry Company, Renton, Washington.[216] But, because the design of the two vehicles was not yet fixed, let alone there being any prototypes that might be mass produced, the Bureau of Ships negotiated a form of cost reimbursement contract with the four firms that it referred to as "maximum price" contracts.[217] It is likely that these were cost-plus-fixed-fee contracts.[218]

The Bureau of Ships designated Ingersoll the "lead yard," "design agent," and "central procurement agent" for the program. The other three companies were "following" yards; they built LVTs that Ingersoll designed and developed, much as Douglas and Lockheed manufactured Boeing's B–47 (see chap. 6).[219] As the "design agent," Ingersoll assembled a team to design the vehicles and coordinated subsequent changes initiated by the Navy, the Marine Corps, or any of the other contractors. As the "central procurement agent," Ingersoll purchased most of the subsystems, components, and other materials that would be used by all the firms involved in manufacturing the LVTs.[220] The Bureau of Ships, both through the Supervisor of Shipbuilding at the company plant and its own staff, monitored Ingersoll's performance. The Marine Corps kept track of the program primarily through a liaison team established by the Marine Corps general officer who was the senior member of the LVT Continuing Board.[221]

Ingersoll's selection as the lead contractor was controversial. Both Ingersoll and the Food Machinery and Chemical Corporation had designed and produced amtracs during World War II, but only the latter had been involved in LVT development since the war.[222] Indeed, in the fall of 1950, the California firm had nearly completed designing a prototype personnel carrier.[223] Although the Food Machinery and Chemical Corporation had the most recent experience with amtracs and a qualified engineering staff in place, the Bureau of Ships chose Ingersoll to be the prime contractor. The determining factor, according to the bureau, was that Ingersoll, not then engaged in any LVT work, was free to devote its full time and resources, including those of its parent Borg-Warner Corporation, whereas the Food Machinery and Chemical Corporation was already occupied in the development and manufacture of the modernized World War II amtracs.[224] Angered by the decision, the company's president complained to the Bureau of Ships, suggesting (to no avail) that development of the Ingersoll prototype should continue, but that the Navy should manufacture the personnel carrier prototype then being finished by the Food Machinery and Chemical Corporation.[225]

Under the contracts awarded to Ingersoll and the other three companies, development and production would take place concurrently. Ingersoll was to design an armored personnel carrier, the LVTP–5, and a howitzer vehicle, the LVTH–6, and construct two prototypes of each. At the same time, Ingersoll and the other firms were to prepare to manufacture the first production run of 109 vehicles, 41 LVTP–5s and 68 LVTH–6s.[226] These contracts, however, represented only the initial order. In February 1951, the Navy had plans, subsequently sharply scaled back, to build almost 2,400 more LVTP–5s and nearly 700 additional LVTH–6s.[227] Ultimately, 1,122 LVTP–5s and 208 LVTH–6s were produced at a cost of approximately $350 million.[228]

Other than differences resulting from function, the LVTP–5 and LVTH–6 possessed similar characteristics. Their hulls, engines, and power trains were identical. But they differed radically from their predecessors in many respects. Over 40 tons when combat-loaded, both were approximately twice the weight of previous LVTs. Their 12-cylinder, liquid-cooled Continental engines produced over 800 horsepower, as opposed to the 400-500 horsepower generated by earlier vehicles. The LVTP–5 carried 34 troops, the LVT–3C, 25. The LVTH–6's 105-mm. howitzer was much more powerful than the 75-mm. howitzers mounted on the LVT(A)5 and LVT(A)4, and its turret and fire control systems were significantly more advanced. On the other hand, the new LVTs, although much faster on land than the most advanced World War II designs (30 mph versus 17 mph), performed only marginally better with respect to speed in the water—6.8 mph as opposed to 6 mph.[229]

According to Ingersoll's contract, the company was to deliver the two personnel carrier prototypes in September 1951 and the two howitzer prototypes three months later. Production of the personnel carrier was to begin at the rate of five vehicles per month in January 1952. Production of the fire support vehicle was to begin at an identical monthly rate, starting in December 1951, the same month that the prototypes were to be delivered.[230] An early schedule agreed to by the Navy, Marine Corps, and Office of the Secretary of Defense, called for a combined total of 1,500 LVTP–5s and LVTH–6s to be completed by the end of FY 1952.[231] The June 1952 completion date corresponded to the time the Truman administration had set for achieving its rearmament objectives.

The LVT program's actual timetable was far off the mark of the originally scheduled milestones. Ingersoll delivered the first LVTP–5 prototype to the Marine Corps for testing at Camp Pendleton in March 1952, five months behind schedule.[232] The first LVTP–5s began coming off the production line that June but without part of the power train, the final drive assembly.[233] In October 1953, following service testing, Fleet Marine Force, Pacific, and Fleet Marine Force, Atlantic, both concluded that the LVTP–5 was not yet acceptable for combat.[234] The first LVTH–6 prototype was completed in July 1952.[235] By March 1954, only 35 had been manufactured—all without the turret and fire control system for the 105-mm. howitzer.[236] In mid-1955, the Marine Corps finally began accepting the LVTP–5 for service with operational units and, in 1956, the LVTH–6.[237]

Almost five years elapsed from the time the Marine Corps approved the characteristics for the new amtracs in September 1950 to the deployment of the LVTP–5 in 1955. In contrast, in the fall of 1941 design work began on the LVT–2; in November 1943, about two years later, the vehicle was in the forefront of the assault on Tarawa Atoll in the Pacific.[238] Certainly the LVTP–5 and LVTH–6 were complex systems with considerably more advanced technologies than those of the World War II amtracs. But not compared to an aircraft carrier. In March 1950, representatives from OPNAV and the bureaus had met to consider the characteristics desirable in a fleet carrier to replace the cancelled *United States*.[239] The eventual outcome of this conference, *Forrestal*, was launched in December 1954 and commissioned in October 1955. In November 1956, about the same time the LVTH–6 was entering service, *Forrestal*—just 6½ years after its characteristics had been determined—was operating in the eastern Atlantic in support of the U.S. response to the Suez Crisis.[240]

Numerous difficulties accounted for the half-decade or so that it took to design, develop, produce, and field the LVTP–5 and LVTH–6. The pressure on resources generated by the large-scale, hurry-up rearmament that began in 1950 resulted in some delays.[241] But two factors caused most of the program's problems. The first was the attempt to undertake development and production simultaneously. The second was the decentralization and fragmentation of acquisition in the Navy.

An acquisition strategy employing concurrency is not likely to meet schedule and cost objectives unless the design is stabilized and major subsystems are available when production begins. Neither was true in the case of the LVTP–5 and the LVTH–6. No detailed design of either vehicle existed when the Navy awarded the contract to Ingersoll. The Marine Corps had provided "general" characteristics for the vehicles and, in line with those specifications, the Bureau of Ships had prepared "general designs" or "preliminary plans" from which the contractor could produce detailed designs.[242] But the bureau's design concept for the personnel carrier was badly flawed.[243] A key deficiency involved the vessel's trim—its ability to maintain equilibrium in the water. To reduce the exposure of troops to fire, the Marines wanted the exit ramp located in the vehicle's stern. To satisfy this requirement, the Bureau of Ships placed the ramp in the rear and the engine and transmission in the front. This arrangement pushed the bow down by as much as a foot and a half. "Such poor trim," the Marine Corps LVT liaison officer reported, "was unacceptable for work afloat and in surf."[244] To correct the problem, Ingersoll had to redesign the vehicle, relocating the engine and transmission and moving the ramp from the stern to the bow.[245]

The design changes involving the LVTP–5's trim were among the first of more than 4,500 that would be made to both vehicles combined by the end of 1955.[246] Design changes, based largely on deficiencies revealed during testing, continued long after quantity production of the LVTP–5 began in June 1952 and of the LVTH–6 in March 1953.[247] Some changes were applied on the production lines and others at a modification center established at the Food Machinery and Chemical Corporation plant in Riverside, California.[248] Eventually more than 100 separate modification "kits," each incorporating numerous changes, were required for the LVTP–5 alone.[249] In a letter to Assistant Secretary of the Navy Raymond H. Fogler in July 1954, Roy Ingersoll, president of Ingersoll Products, attributed the extensive modifications to concurrency: "Had we had time to properly design and engineer a pilot model, then fully testing it to find any weaknesses that developed and making any necessary changes to assure its being a completely satisfactory combat vehicle . . . would have saved modification work that is now necessary to perform."[250]

The nearly continuous change process that resulted from overlapping development and production not only delayed acceptance of the LVTs but also drove up the program's costs.[251] In January 1951, the Bureau of Ships had estimated the cost of the LVTP–5 personnel carrier at $170,000 per vehicle and the turreted LVTH–6 at $270,000 each. Had those estimates been accurate, the program should have cost approximately $250 million instead of $350 million.[252]

Problems with key subsystems—the final drive assembly (identical in both vehicles) and the turret and fire control system for the LVTH–6—were responsible for much of the delay in completing the designs. Coming up with a final drive that would provide the maneuverability required by the large and heavy LVTs proved to be especially daunting.[253] As late as June 1953, a year after production of the LVTP–5 began, the assistant chief of staff (G–4) at Marine Corps headquarters, reported to the chief of staff: "The final drive problem is improved but not solved. Improvements tested to date have reduced the frequency of the failures. A final solution is not in sight."[254]

For the LVTH–6, the longest pole in the development tent was not the final drive but the lack of a mechanized turret and fire control system for the 105-mm. howitzer. The source for both was the Army's Ordnance Corps. In February 1951, more than a month after the contract was awarded to Ingersoll, the Bureau of Ships learned that many of the components for the turret and fire control systems were "not available, obsolete, or could not be integrated with the other components involved."[255] The Marine Corps decided against installing interim systems. The first acceptable turret and fire control systems were not available until November 1954—nearly three years after LVTH–6 production was originally scheduled to begin.[256] Production of the LVTH–6 actually started in the spring of 1953, and the vehicles rolled off the assembly line without turrets.[257] As late as mid-1955, over 90 turret-less steel hulks—almost half the LVTH–6 production order—still sat impotently in the factories or in the modification center.[258]

Most of the explanation for the several years that were required to field the LVTP–5 and LVTH–6 lies at concurrency's seductive door, but the Navy's Balkanized acquisition structure also shares some of the blame. First, a gap existed between requirements and development—between the consumer, the Marine Corps, and the producer, the Bureau of Ships. The best evidence for this is that the Marines were not satisfied with any of the prototypes available in the fall of 1950. The lack of an acceptable prototype combined with the apparent urgency of the international situation led the Marine Corps to insist on a crash program based on a completely new design with concurrent development and production.

Bureau of Ships dominance of the LVT Continuing Board until the start of the Korean War may have been one reason for the gulf between requirements and development. But the existence of the board, whether controlled by the Navy or Marine Corps, was a further reflection of fragmentation in the service's organization for acquisition that hindered the LVT program. In mid-1951, for example, the bureau sought a quick decision from the Marine Corps on whether to pursue an interim system for the LVTH–6 turret. The request went directly to Marine Corps headquarters for an answer. The bureau was told, however, that the LVT Continuing Board must first make a recommendation to the commandant, who would then seek the CNO's approval. "This procedural roadblock," wrote one Bureau of Ships officer, "meets us at every turn when even insignificant or unimportant decisions are involved. It is ridiculous to scuttle a supposedly important and urgent program by strangling operations with procedural red tape."[259] Obtaining approval for changes by this route usually took more than 3 months. Indeed, early in 1952, the resident Supervisor of Shipbuilding at Ingersoll estimated that the LVT program would have been 6 to 12 months further behind schedule than it already was at that point had not the contractor implemented many design changes without authorization.[260]

Most assessments of the LVT program, while acknowledging the increased costs and delays that resulted from concurrent development and production, justified the price that was paid by citing the security threat believed to exist at the time. In August 1953, the assistant chief of staff (G–4) at Marine Corps headquarters wrote: "Faced with what was in 1950 considered to be the prospect of imminent global war, the decision to accept the foreseen risks [of a crash program] was probably sound."[261] That same month, Ingersoll's president made the same point to the chief of the Bureau of Ships: "(T)he world conditions that existed when this program was undertaken did not permit the delay that would be inevitable if the design were to be developed to optimum performance by model testing, component development and prototype testing, as would be the normal procedure under peacetime conditions."[262] The judgment of an observer not directly involved in the program was less forgiving. In 1952, without the knowledge of the Bureau of Ships, the Office of the Chief of Naval Material opened a quiet inquiry. Howard B. Lewis, the investigator, was candid:

> It appears that the whole program was ill-advised and unrealistically approached. If it was determined in December of 1950 or January 1951 that production vehicles were required in October 1951, it should have been obvious that it was physically impossible to design and produce an entirely new vehicle to meet that requirement, and the best vehicle then tested and proven should have been ordered. Even then almost superhuman effort would have been required to meet the schedule.[263]

In late 1950 and early 1951, as described elsewhere in this volume, the Navy and Marine Corps were not alone among the services in launching accelerated, costly, and trouble-plagued acquisition programs in response to the perceived danger of war with the Soviet Union. Only hindsight, of course, permits the judgment that the more deliberate approach might have been the wiser, and surely less expensive, course to follow.[264]

Deficiencies in acquisition organization, program management, and the system development approach exacerbated the problems created by acceleration. The Navy's fragmented acquisition structure created a fissure between consumer and producer that left the Marine Corps without acceptable LVT prototypes in the fall of 1950. Thereafter, divided and overlapping management responsibilities added to the delays that occurred as development and production took place simultaneously. Additionally, the Navy's approach to system development, as reflected in the difficulties surrounding the LVTH–6's turret and fire control systems—that a weapon system was a collection of components to be cobbled together into a whole—had become increasingly inappropriate as systems grew more complex, sophisticated, and interdependent after World War II. In 1963, the Marine Corps, involved in acquiring a successor to the LVTP–5, studied how amtrac programs had been managed in the past. One conclusion was that programs initiated during World War II succeeded because a single, central authority, the Bureau of Ships, supervised engineering, production, and follow-on support. In contrast, according to the staff analysis, the LVTP–5 program suffered because responsibility for these functions was "parceled out." Future LVT programs, concluded the staff study, while conducted in cooperation with the Bureau of Ships, should be centrally managed by the Marine Corps.[265]

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At the end of the Korean War, decentralization continued to be the dominant feature of acquisition in the Navy. Despite OPNAV's increasing power and the tendency toward more centralized management as reflected in the creation of the Navy's Research and Development Review Board, the technical bureaus still possessed considerable autonomy in acquiring the service's weapon systems. Critics of the bureau structure tend to focus on weaknesses and overlook strengths. One of the latter was that a bureau could act more rapidly than the service as a whole. Thus, for example, the Bureau of Aeronautics' expeditious pursuit of a heavy attack aircraft, the AJ–1, enabled the Navy to realize a long-range nuclear weapons delivery capability much sooner than it would have had the bureau awaited direction from above. Notwithstanding the ability of the product-oriented bureaus to act quickly, their independence worked against the need to integrate individual systems, such as an aircraft, a ship, or a missile into systems of systems. In jealously guarding their prerogatives, the bureaus impeded this essential process. Moreover, as with the LVTP–5 and LVTH–6, the bureaus still largely viewed a weapon system as a collection of subsystems that were separately developed rather than as a product with all of its elements carefully designed from the outset as an integrated whole.

Not only was acquisition in the Navy decentralized, it was also badly fragmented. Until late 1950, divisions in OPNAV issued requirements independently, resulting in confusion regarding development priorities. For at least five years after World War II, the duties of the Ship Characteristics Board in OPNAV and the General Board in the Office of the Secretary of the Navy overlapped with respect to determining ship characteristics and the content of the annual shipbuilding and conversion program. No office within the Navy monitored the whole of the service's research, development, test, and evaluation effort. The Marine Corps and Bureau of Ships competed for management of the LVT program. The widespread fragmentation of acquisition responsibilities within the Navy compounded the problems that stemmed from decentralization.

After the Korean War, trends in Navy acquisition under way since World War II continued. Centralization increased, and bureau independence and importance diminished. When setting out to develop the high-priority intermediate range ballistic missile, the Polaris, the service turned not to the bureaus but instead created a new organization, the Special Projects Office, a management structure for developing and deploying new systems that was designed to cut across bureau boundaries. But even in decline, the bureaus proved tenacious. Reform efforts would be aimed at preserving, not replacing them.

Endnotes

1. Steven L. Rearden, *The Formative Years, 1947–1950*, Vol. I, *History of the Office of the Secretary of Defense*, 16-23. In hearings before the Senate Naval Affairs Committee in May 1946, Fleet Admiral Chester W. Nimitz, the chief of naval operations, expressed one of these fears openly: "I believe it is the ultimate ambition of the Army Air Force to absorb naval aviation in its entirety and set up one large air force." See statement of Fleet Admiral Chester W. Nimitz, Senate Committee on Naval Affairs, *S. 2044, A Bill to Promote the Common Defense by Unifying the Departments and Agencies of the Government Relating to the Common Defense: Hearings before the Committee on Naval Affairs*, 79th Cong., 2d sess., 3 May 1946, 101.
2. Statement of Adm. Ben Moreell, Chief of the Material Division, Office of the Assistant Secretary of the Navy, 9 May 1946; and statement of Vice Adm. Robert B. Carney, Deputy Chief of Naval Operations for Logistics, 11 July 1946: both in *S. 2044 . . . Hearings before the Committee on Naval Affairs*, 199-202, 331-35. Several historians of the postwar Navy have echoed Admiral Moreell's "persons, not organizations" point of view. Richard G. Hewlett and Francis Duncan maintain that the key to Rear Adm. Hyman G. Rickover's success in the Navy's nuclear propulsion program was his emphasis "on individuals, not systems." See Richard G. Hewlett and Francis Duncan, *Nuclear Navy, 1946–1962*, 385-91. See also Duncan's *Rickover and the Nuclear Navy: The Discipline of Technology*, 232-51, 279-84. Similarly, in his history of the Navy's submarine development programs since World War II, Gary Weir argues that it was not organizational structures that accounted for success but rather the network of personal relationships between naval officers and civilians; scientists, engineers, and managers; industry, the academic community, and the Navy that had been forged during the war and continued through the 1950s. See Gary E. Weir, *Forged in War: The Naval Industrial Complex and American Submarine Construction, 1940–1961*, 6, 146-47, 165, 171, 251, 265, 271, 273.
3. Jan S. Breemer, *U.S. Naval Developments*, 17; Jeffrey G. Barlow, *Revolt of the Admirals: The Fight for Naval Aviation, 1945–1950*, 161; and Alan R. Millett, *Semper Fidelis: The History of the United States Marine Corps*, 447. Of the nearly 2,500 vessels, about half were major combatants, and half transports.
4. Robert W. Love, Jr., *History of the U.S. Navy*, Vol. II, *1942–1991*, 281-85.
5. Before the end of World War II, planners used the British fleet as the basis for sizing the

postwar Navy. See Elliott V. Converse III, *Circling the Earth: United States Plans for a Postwar Overseas Military Base System, 1942–1948*, 63-64. For the influence of traditional naval theory, especially the ideas of Alfred Thayer Mahan, on the Navy's postwar planning, see Vincent Davis, *Postwar Defense Policy and the U.S. Navy, 1943–1946*, 37, 162-65.
6. Malcolm Muir, Jr., *Black Shoes and Blue Water: Surface Warfare in the United States Navy, 1945–1975*, 16-18, 43-44; Love, *History of the U.S. Navy*, 385; Robert L. Scheina, "Search for a Mission, 1945–1950," in *Naval Engineering and American Seapower*, ed. Randolph W. King, 262-67; Michael A. Palmer, *Origins of the Maritime Strategy: American Naval Strategy in the First Postwar Decade*, 24, 26; and Dean C. Allard, "An Era of Transition, 1945–1953," in *In Peace and War: Interpretations of American Naval History, 1775–1978*, ed. Kenneth J. Hagan, 295-96.
7. Muir, *Black Shoes and Blue Water*, 17; Barlow, *Revolt of the Admirals*, 115; and Palmer, *Maritime Strategy*, 27.
8. Palmer, *Maritime Strategy*, 60-61.
9. David A. Rosenberg, "American Postwar Air Doctrine and Organization: The Navy Experience," in *Air Power: Promise and Reality*, ed. Mark K. Wells, 190.
10. Barlow, *Revolt of the Admirals*, 125-27.
11. Chester W. Nimitz, "Adm. Nimitz Sees Navy With Air As First Line" ("The Future Employment of Naval Forces"), *Army-Navy Journal* 85, no. 19 (10 January 1948): 495. For analysis of the so-called "Nimitz Valedictory," see Barlow, *Revolt of the Admirals*, 52-56; Palmer, *Maritime Strategy*, 36-37; and Rosenberg, "Postwar Air Doctrine," 182.
12. Rearden, *Formative Years*, 393-402.
13. Palmer, *Maritime Strategy*, 42-47.
14. Barlow, *Revolt of the Admirals*, 115-17; and Rosenberg, "Postwar Air Doctrine, 197.
15. Rearden, *Formative Years*, 410-12.
16. My account of these events depends heavily on Barlow, *Revolt of the Admirals*, 215-77. Barlow argues that the testimony of the Navy's top officers "made the case for a strengthened naval aviation component, and beyond that, for the importance of the Navy as a whole, at a time when the service's role in national defense was under severe attack by organizations and individuals having little understanding of its value" (p. 268).
17. Ibid., 224. By the spring of 1950, 3 had been restored to the budget, bringing to 7 the total number of attack carriers authorized for FY 1951.
18. Rosenberg, "Postwar Air Doctrine," 190.
19. Barlow, *Revolt of the Admirals*, 160.
20. For the FY 1948 figures, see ibid. For the FY 1949 through FY 1951 figures, see Rearden, *Formative Years*, table 3 (Congressional Action on FY 1949 Military Budget), 333; table 5 (Congressional Action on FY 1950 Military Budget), 360; and table 7 (Congressional Action on FY 1951 Military Budget), 380.
21. Table 8 (Navy Operating Forces, Fiscal Years 1947–1949), in Barlow, *Revolt of the Admirals*, 161; and Walter S. Poole, *The Joint Chiefs of Staff and National Policy, 1950–1952*, 20.
22. Millett, *Semper Fidelis*, 465. The Marine Corps believed it required 114,000 personnel to fulfill its peacetime commitments.
23. See the table (Brief of Operating Forces), n.d. (but 1951), folder Naval and Marine Forces, 1951, box 7, Papers of Forrest P. Sherman [hereafter Sherman Papers], Operational Archives Branch [hereafter OAB], Naval Historical Center [hereafter NHC], Washington, D.C.
24. Statement of the Chief of the Bureau of Ships Relative to the Bill H. R. 7764, "To Authorize the Construction of Modern Naval Vessels, and for Other Purposes," n.d. (but 1950), folder Correspondence of the Chief of Naval Operations on the bill H. R. 7764, box 9, Op–00 Files, 1950, OAB, NHC. For the FY 1950 shipbuilding figure, see Paolo E. Coletta, "Francis P. Matthews," in *American Secretaries of the Navy*, Vol. II, *1913–1972*, ed. Paolo E. Coletta, 821; and for the FY 1950 budget, see table 5 (Congressional Action on FY 1950 Military Budget), in Rearden, *Formative Years*, 360.
25. Department of the Navy, *Annual Report of the Secretary of the Navy for Fiscal Year 1947*, 40.

26. Norman Polmar, "Building the United States Fleet, 1947–1967," in *Brassey's Annual: The Armed Forces Year-Book, 1966*, ed. J. L. Moulton, C. N. Barclay, and W. M. Yool, 69-70. The aborted carrier *United States* is not counted in this total.
27. At the beginning of 1950, Navy shipyards on the East Coast were located at Boston, Mass.; Charleston, S. C.; Brooklyn, N.Y.; Norfolk, Va.; Philadelphia, Pa.; and Portsmouth, N.H. West Coast shipyards were at Mare Island, Calif.; Pearl Harbor, Territory of Hawaii; Bremerton, Wash. (Puget Sound Naval Shipyard); and San Francisco, Calif.
28. Ltr, Adm. Forrest Sherman, Chief of Naval Operations, to Secretary of the Navy, 15 July 1950, folder A1, Plans, Projects, and Policies, box 1, Formerly Classified Correspondence of Secretary Francis P. Matthews, 1949–1950, RG 428 (General Records of the Department of the Navy, 1947), Archives II.
29. See table 5 (FY 1951 Appropriations), table 8 (FY 1952 Appropriations), and table 12 (FY 1953 Appropriations): all in Doris M. Condit, *The Test of War, 1950–1953*, 241, 259, 284.
30. Table 8 (Actual Force Levels of U.S. Armed Forces: 1952–1956), in Robert J. Watson, *The Joint Chiefs of Staff and National Policy, 1953–1954*, 84.
31. Semiannual Report of the Secretary of the Navy, January 1 to June 30, 1950, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1950*, 112; and Semiannual Report of the Secretary of the Navy, January 1, 1953 to June 30, 1953, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1953*, 213.
32. App. 2 (Strength of the Marine Corps), in Millett, *Semper Fidelis*, 628.
33. Muir, *Black Shoes and Blue Water*, 34; and Clark G. Reynolds, "Forrest Percival Sherman," 217-18, and Gerald Kennedy, "William Morrow Fechteler," 238-39: both in *The Chiefs of Naval Operations*, ed. Robert William Love, Jr.
34. Table 4 (Forces in Being, 1950–1952), in Poole, *Joint Chiefs of Staff and National Policy, 1950–1952*, 71; and Muir, *Black Shoes and Blue Water*, 36.
35. Muir, *Black Shoes and Blue Water*, 36.
36. Semiannual Report of the Secretary of the Navy, January 1, 1953 to June 30, 1953, 208. *Nautilus* was launched in January 1954, *Forrestal* in December 1954, *Seawolf* in July 1955, and *Saratoga* in October 1955.
37. Muir, *Black Shoes and Blue Water*, 67-68.
38. Barlow, *Revolt of the Admirals*, 68-72; and Muir, *Black Shoes and Blue Water*, 7-8.
39. For a summary of Navy jet development through mid-1946, see ltr, Rear Adm. L. B. Richardson, Deputy and Assistant Chief of the Bureau of Aeronautics, to Assistant Secretary of the Navy for Air [John L. Sullivan], 4 June 1946, sub: Jet Propelled Aircraft Development in the United States, folder Day Copies, 3 June 1946–15 June 1946, box 2, entry 69 (Records of Divisions and Offices, Central Correspondence; Day Copies of Confidential Correspondence, April 1946–December 1947), RG 72 (Records of the Bureau of Aeronautics), Archives II.
40. Roy A. Grossnick, *United States Naval Aviation, 1910–1995,* 163-64, 171. After 1946, the Navy's designation for McDonnell Aircraft Corporation changed from "D" to "H."
41. During this period, jets landed at approximately 110 knots (about 125 mph) and piston-engine aircraft around 65 knots (about 75 mph).
42. Love, *History of the U.S. Navy*, 378.
43. Ltr, Capt. C. F. Coe, Op–55 [Office of the DCNO, Air], to Capt. A. B. Vosseler, Weapons Systems Evaluation Group, 18 April 1950, sub: Aircraft Carriers, U.S. Navy, folder EA-EM, box 707, entry 2 (Records of the Secretary of the Navy, General Records; Formerly Security Classified General Correspondence of the Deputy Chiefs of Naval Operations, 1948–1951), RG 428.
44. Chart 9 (Navy Carrier Types), atch to exhibit 8 (The Navy's Peacetime Aircraft Procurement Program, Five Year Plan, 1 January 1948), in Navy Department Presentation to the Congressional Aviation Policy Board (Subcommittee on Combat Aviation), 20 January 1948, box 5, Formerly Classified Correspondence of Secretary John L. Sullivan, 1947–1949 [hereafter

Sullivan Papers], RG 428; Bureau of Aeronautics Research and Development Quarterly Progress Report, 1 August 1949, 16, folder A9-3, box 416, entry 2, RG 428; ltr, Rear Adm. A. M. Pride, Chief, Bureau of Aeronautics, to Chief of Naval Operations, 18 November 1949, sub: Cost of long range carrier attack program, folder L1-1, box 24, entry 1004B (Secret General Correspondence, 1949), RG 72; Characteristics Summary, XA2J–1, 15 December 1949, folder F1-F13, box 715, entry 2, RG 428; and memo, L. D. Coates, Deputy Director, Piloted Aircraft Division, Bureau of Aeronautics, for Op–551 (Office of the DCNO, Air), 12 January 1950, sub: Heavy Attack Aircraft; Capabilities of, folder JA, box 718, entry 2, RG 428. The XA2J–1 never went into production. It should not be confused with the AJ–2, an improved model of the AJ–1.
45. Hal Buell, "The Angled Deck Concept—Savior of the Tailhook Navy," *The Hook* 15, no. 3 (Fall 1987): 13-23.
46. Ibid., Norman Friedman, *U.S. Aircraft Carriers: An Illustrated Design History*, 263-64; Love, *History of the U.S. Navy*, 378-79; and Willis C. Barnes, "Korea and Vietnam, 1950–1972," in *Naval Engineering and American Seapower*, 297-98.
47. Friedman, *U.S. Aircraft Carriers*, 380. Fully loaded, the AJ–1 Savage weighed about 52,000 pounds; its successor, the A3D Skywarrior, weighed approximately 70,000 pounds.
48. For a detailed and well-documented account of the history of guided missile development in the Navy through mid-1948 by a key participant, see the unpublished manuscript by Rear Adm. Delmer S. Fahrney, "The History of Pilotless Aircraft and Guided Missiles," [ca. 1958], box 91, entry 204 (Correspondence Relating to the Preparation of Rear Admiral D. S. Fahrney's History of Pilotless Aircraft and Guided Missiles), RG 72.
49. Office of the Chief of Naval Operations, "Review of the Naval Guided Missiles Program," 1 January 1948, box 4, entry 1 (Records of the Secretary of the Navy, General Records; Formerly Security Classified CNO/SEC NAV General Correspondence [OPNAV], 1948–1951), RG 428.
50. Table (Summary of Recommendations of Director of Guided Missiles, Navy), 26 July 1952, folder CD 470 (Jul.–Oct. 31) 1952, box 385, entry 199 (Confidential Through Top Secret Subject Correspondence File, 1947–1953), RG 330.
51. Scheina, "Search for a Mission," 268.
52. Muir, *Black Shoes and Blue Water*, 63-67; and Love, *History of the U.S. Navy*, 384.
53. Ron Westrum, *Sidewinder: Creative Missile Development at China Lake*, 43-46. There were three versions of the Sparrow. Sparrow II, developed by Douglas Aircraft and the Bendix Corporation, did not succeed. Sparrow I was the first to be operational, but Sparrow III, developed by Raytheon, soon replaced it.
54. Ibid., 115-16, 123, 130-31.
55. Muir, *Black Shoes and Blue Water*, 32, 50-51, 92-94; Floyd D. Kennedy, Jr., "The Creation of the Cold War Navy, 1953–1962," in *Peace and War*, 308; and especially David K. Stumpf, *Regulus: The Forgotten Weapon*, a full-length study of the development and deployment of Regulus I and its follow-on, Regulus II.
56. Jacob Neufeld, *Ballistic Missiles in the United States Air Force, 1945–1960*, 54-55, 83-92. Early in 1949, the Navy notified the Army and Air Force that it would not pursue development of any surface-to-surface missile with a range exceeding 2,000 miles. See ltr, Vice Adm. J. D. Price, Deputy Chief of Naval Operations for Air, to Chief of Staff, United States Army, 18 January 1949, sub: Very Long Range Guided Missiles, Responsibility for Development, folder F41-1/VV, box 293, entry 1, RG 428.
57. Rear Adm. C. W. Styer, Acting Deputy Chief of Naval Operations (Operations), Presentation before the House Appropriations Naval Subcommittee, 5 February 1948, 3, box 5, Sullivan Papers, RG 428.
58. The terms denoting the major division in the Navy's acquisition structure—"bilinear," "consumer logistics," "producer logistics," "naval command," and "business management"—are used in the general orders specifying the Navy's organization and in the periodic official publications describing it. See, for example, Office of the Management Engineer, Department of the Navy, *The United States Navy: A Description of Its Functional Organization*, 14-15; Office

of the Management Engineer, Department of the Navy, *The United States Navy: A Description of Its Functional Organization*, 8-9; and Navy Management Office, Department of the Navy, *The Department of the Navy*, 7-9. The terms reflect the postwar outcome of the struggle between Admiral Ernest J. King, who held the dual posts of chief of naval operations and commander-in-chief of the U.S. Fleet, and the Navy's civilian leadership for control of procurement during World War II. See Robert Greenhalgh Albion and Robert Howe Connery, *Forrestal and the Navy*, 238.

59. *Functional Organization*, July 1948, 17; and *Functional Organization*, October 1952, 10.

60. David K. Allison, "U.S. Navy Research and Development since World War II," in *Military Enterprise and Technological Change: Perspectives on the American Experience*, ed. Merritt Roe Smith, 300-01. During World War II, to speed production, the Navy decentralized procurement to the bureaus, and created the Office of Procurement and Material in the Office of the Secretary of the Navy to provide policy direction for and coordination of their activities. In 1945, the Office of Procurement and Material became the Material Division, and in 1948, the Office of the Chief of Naval Material. See Julius Augustus Furer, *Administration of the Navy Department in World War II*, 439, 840-41.

61. Booz, Allen & Hamilton, Inc., *Review of Navy R&D Management, 1946–1973*, 10. The sources supporting this excellent study have been deposited at the Operational Archives Branch of the Naval Historical Center under the title, Records of Booz, Allen & Hamilton, 1946–1973 [hereafter BAH Records].

62. Commodore R. M. Watt, Jr., "Organization of the Office of the Assistant Secretary of the Navy," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 31 January 1946, 15, NDU Library.

63. Ibid., 12-16. For a detailed history of the Office of Naval Research, see Harvey M. Sapolsky, *Science and the Navy: The History of the Office of Naval Research*. For shorter accounts focusing on ONR's origins, see Sapolsky, "The Origins of the Office of Naval Research," in *Naval History: The Sixth Symposium of the U.S. Naval Academy*, ed. Daniel M. Masterson, 206-25; and Raymond D. Hagen, "The Office of Naval Research: Windows to the Origins," *Naval Research Reviews* 38, no. 3 (1986): 4-25.

64. Allison, "Research and Development," 290-91; Rodney P. Carlisle, *Navy RDT&E Planning in an Age of Transition: A Survey Guide to the Contemporary Literature*, 1, 11-12; and Carlisle, *Management of the U.S. Navy Research and Development Centers During the Cold War: A Survey Guide to Reports*, xv, 14-15.

65. Rear Adm. Paul F. Lee, "Research and Development in the Navy," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 25 November 1947, 4, NDU Library.

66. Sapolsky, *Science and the Navy*, 57-65.

67. Ibid., 98-111.

68. Booz, Allen & Hamilton, *Navy R&D Management*, Vol. I, 13. The bill introduced into the House of Representatives creating the Office of Naval Research provided for the office's control of the Navy's entire research program. Vice Adm. Harold G. Bowen, the first chief of naval research, favored this broader authority but the Senate version of the legislation substituted coordination for control. See Harold G. Bowen, *Ships, Machinery, and Mossbacks: The Autobiography of a Naval Engineer*, 351-52.

69. Thomas C. Hone, *Power and Change: The Administrative History of the Office of the Chief of Naval Operations, 1946–1986*, 2, 18. In November 1945, the chief of naval operations established the Office of the Deputy Chief of Naval Operations for Special Weapons (Op–06) with responsibility for guided missiles and atomic energy. In November 1946, Op–06 was dissolved because of conflicts with other staff elements over cognizance issues. Its duties with respect to the application of atomic energy were assumed by a division in the Office of the Deputy Chief of Naval Operations for Operations (Op–03) and those regarding guided missile development by a division in the Office of the Deputy Chief of Naval Operations for Air (Op–

05). See Barlow, *Revolt of the Admirals*, 78-80. In 1971, under CNO Admiral Elmo R. Zumwalt, Jr., a reorganization of OPNAV added deputy chiefs of naval operations for surface and for submarine warfare, thus balancing the number of functional and platform oriented deputy chiefs. See Hone, *Power and Change*, 91.
70. Booz, Allen & Hamilton, *Navy R&D Management*, Vol. I, 37.
71. For the Operations Evaluation Group from its origins through the early 1980s, see Keith R. Tidman, *The Operations Evaluation Group: A History of Naval Operations Analysis*.
72. Dr. A. A. Brown, Operations Evaluation Group, "Operations Evaluation Group," 2, in Navy Presentation to the Joint Chiefs of Staff Special Budgetary Assistants on the Navy Research and Development Program, Fiscal Year 1950, 2 September 1948, folder L1-1, box 230, entry 1, RG 428.
73. Ibid., 3.
74. Capt. J. H. Hogg, "The Operational Development Force," 1-2, ibid. In 1948, along with about 100 aircraft, ships permanently assigned to the Operational Development Force included the light carrier *Saipan*, the battleship *Mississippi*, the cruiser *Macon*, and several destroyers and destroyer escorts.
75. In February 1950, Op–03 established the Ship Requirements Board for these purposes. The chairman and the board members came from Op–03; officers from Op–04, Op–05, and the Marine Corps met with the board and submitted the views of their organizations but were not members. See memo, Vice Adm. A. D. Struble, Deputy Chief of Naval Operations for Operations, for Op–03B, Op–31, Op–33, and Op–34, 2 February 1950, sub: Ship Requirements Board, Establishment of, folder QB (N-Z), box 709, entry 2, RG 428.
76. *Functional Organization*, July 1948, 17.
77. Furer, *Administration of the Navy Department*, 166. A ship's characteristics included its hull; propulsion; armament, fire control, and ammunition; armor protection; communications and electronics; command and ship control (bridges); aviation features (if applicable); ship's complement (berthing, messing, and sanitation for the crew); and provisions and stores.
78. Beginning early in 1951, the chairman of the Ship Characteristics Board could be any flag-rank officer serving in OPNAV. See ltr, Francis P. Matthews, Secretary of the Navy, to Chief of Naval Operations, 22 January 1951, sub: Appointment of a Ship Characteristics Board, folder OPNAV and Navy Department Reorganization, 1950–1951, box 7, Sherman Papers, OAB, NHC.
79. Hone, *Power and Change*, 20.
80. For the evolution of the role of the General Board through World War II, see Paul Y. Hammond, *Organizing for Defense: The American Military Establishment in the Twentieth Century*, 54-55; and Davis, *Postwar Defense Policy*, 65.
81. Robert T. Carney [deputy chief of naval operations, logistics, 1946–1949, and chief of naval operations, 1953–1955], interview by John T. Mason, Jr., Columbia University Oral History Program, 17 October 1963, Washington, D.C., copy in OAB, NHC.
82. Edward A. Ruckner, interview by John T. Mason, Jr., U.S. Naval Institute Oral History Program, 30 January 1974, 146-47, copy in OAB, NHC.
83. Ibid., 149.
84. *Functional Organization*, July 1948, 24-25; and *Functional Organization*, October 1952, 16.
85. Booz, Allen & Hamilton, *Navy R&D Management*, Vol. I, 122-23.
86. Of the $207.7 million appropriated for R&D in FY 1948, 64.4 percent went to industry, universities and other nonprofit institutions; of the $453 million appropriation for FY 1952, 67.3 percent. For the FY 1948 figures, see Lee, "Research and Development in the Navy," 10. For the FY 1952 figures, see Research and Development Board, "Budget and Fiscal Information on Research and Development Program, FY 1952–FY 1954 (RDB 106/25)," 25 September 1952, 16, folder RDB 106.7, Fiscal Year 1954, box 497, entry 341 (Research and Development Board), RG 330.
87. For a listing of these facilities in 1947, see Booz, Allen & Hamilton, *Navy R&D*

Management, Vol. I, 116. BuAer's major facilities were the Naval Air Material Center, Philadelphia, Pa.; the Naval Air Missile Test Center, Pt. Mugu, Calif.; and the Naval Air Test Station, Patuxent River, Md. BuOrd's were the Naval Ordnance Laboratory, Washington, D.C. (after 1948, White Oak, Md.); and the Naval Ordnance Test Station, Inyokern, Calif. (China Lake). BuShips' were the David Taylor Model Basin, Carderock, Md.; the Naval Electronics Laboratory, San Diego, Calif.; and the U.S. Navy Underwater Sound Laboratory, New London, Conn.

88. Capt. J. M. Lane, "Organization of the Office of the Chief of Naval Operations," address to the Army Industrial College, Fort Lesley J. McNair, Washington, D.C., 31 January 1946, 6, NDU Library.

89. Rear Adm. Morton L. Ring, "Contract Administration, Navy," address to the Army Industrial College, Fort Lesley J. McNair, Washington, D.C., 8 March 1946, 4, NDU Library.

90. Interim Systems Coordination Facility, Naval Research Laboratory, "A Survey of Systems Coordination," 1 May 1951, II-16, II-19, folder A11 (Systems Coordination), 13 October 1951, box 1023, entry 1, RG 428.

91. Ltr, Chief of the Bureau of Ordnance and Chief of the Bureau of Aeronautics, to Chief of Naval Operations, 16 November 1945, sub: Coordination of Guided Missile and Pilotless Aircraft Programs, folder IBTC, Minutes, 1946–June 1947, box 24, entry 224 (Inter-Bureau Technical Committee, 1945–1957), RG 72; app. B (Charter of the Inter-Bureau Technical Committee on Guided Missiles) to minutes of meeting of BuAer/BuOrd Joint Technical Committee, 10 October 1946, ibid. (quoted material); and Fahrney, "History of Pilotless Aircraft and Guided Missiles," 1107-08.

92. Bureau of Ordnance, "An Analytical Report of the Bureau of Ordnance Guided Missile Program," June 1950, 27, box 10, BAH Records, OAB, NHC.

93. This summary of the Navy's R&D program management system is drawn largely from Booz, Allen & Hamilton, *Review of Navy R&D Management*, Vol. I, 185-96.

94. The illustration, Navy Research and Development Program, is Navy chart no. 5 in "Review by the Deputy Secretary of Defense of Military Programs Involved in the Implementation of NSC 68," 20 October 1950, folder CD 381 (War Plans, NSC 68), October 1950, box 201, entry 199, RG 330. The planning objectives corresponded to the "warfare categories" of the Research and Development Board's Master Plan for Research and Development; the operational and research requirements were grouped according to the "technical objectives" listed under each "warfare category" (see chap. 2). After the Research and Development Board published the first fully developed Master Plan for Research and Development in early 1949, the Navy reworded and reordered its own planning objectives, originally published in mid-1948, to conform to the Master Plan's "warfare categories." See, for example, the chart "R&D Planning Objectives," in Rear Adm. Jerauld Wright [director, Operational Readiness Section, Op-03], "Introduction," to Navy Presentation to the Joint Chiefs of Staff Special Budgetary Assistants on the Navy Research and Development Program, Fiscal Year 1950, 2 September 1948, folder L1-1, box 230, entry 1, RG 428.

95. The following are examples of a planning objective, an operational requirement, and a research requirement from the Navy's Research and Development Plan for FY 1951: Planning Objective CA (Combat Air Operations): "To develop aircraft with their equipment and armament and aircraft carrier components to enable naval forces to make offensive air strikes at sea and from the sea or to provide reconnaissance and long range assault." Operational Requirement CA–02501: "Develop special attack aircraft for operation from large attack type carriers (and from CVB type carriers when possible) capable of striking targets at sea and from the sea, and capable of carrying an atomic bomb, without regard to conditions of weather and visibility, to combat radii up to 2,000 nautical miles with various weapons. Special measures (as refueling, relaxation of tactical restrictions, etc.) to permit operation at this maximum range are permissible if the efficiency at more typical operating radii of 1,000–1,200 miles is sufficiently improved." Supporting Research Requirement SR–03804: "Fluid Mechanics—To

increase theoretical and experimental knowledge of the motion of fluids and the interaction of various shapes with moving fluid media. An objective of this program is the utilization of this information to improve the performance of naval vehicles to transport personnel, instruments, explosives, etc. through the air, on the surface, or under the surface of the sea." See encl. A (Revised Navy Plan for Research and Development), 17-18, 42, to ltr, John Nicholas Brown, Acting Secretary of the Navy, to Chief of Naval Operations, 8 March 1949, sub: Navy's 1951 Research and Development Plan, Revision of, folder A1-1, Plans and Policies, box 407, entry 2, RG 428.

96. In FY 1948, the Navy was pursuing approximately 6,600 individual R&D projects; in FY 1951, more than 8,000. See Lee, "Research and Development in the Navy," 25 November 1947, 10; and Department of the Navy, *Research and Development Survey Board* [Kendall Board, after its chairman Rear Adm. H. S. Kendall] *Progress Report*, 1 July 1950, 3-7, folder EN1 (Naval Research)/A23, box 1088, entry 1, RG 428.

97. Encl. to ltr, Chief of Naval Operations to Distribution List, 20 September 1950, sub: Navy Research and Development Projects, folder A11/A1 to A11/ZZ, box 1019, entry 1, RG 428.

98. Ibid.

99. Booz, Allen & Hamilton, *Review of Navy R&D Management*, Vol. I, 191. Approximately 300 operational requirements were in effect in the fall of 1950. See "Review by the Deputy Secretary of Defense of Military Programs Involved in the Implementation of NSC 68," 20 October 1950, 27.

100. Vice Adm. John T. Hayward, USN (Ret.), interview by Peter Bruton and Capt. Robert L. Hansen, USN (Ret.), Booz, Allen & Hamilton, 9 October 1974, 26, box 874, Oral History Collection, Archives of the Navy Laboratory Center Coordinating Group, 1940s–1990s, OAB, NHC.

101. Ltr, Chief of Naval Operations to Distribution List, 7 November 1949, sub: Fleet Air Defense Priority, folder A16/A16-3, box 681, entry 2, RG 428. See also memo, Rear Adm. R. P. Briscoe, Chairman, Navy Research and Development Review Board, for Distribution List, 26 January 1949, sub: First Review of the Navy Research and Development Program, folder A1/A1-4, box 274, entry 1, RG 428.

102. Ltr, Rear Adm. R. P. Briscoe, Chairman, Navy Research and Development Review Board, to [members of the board], 11 July 1949, sub: Proposals for Improvement of the Research and Development Planning System, folder A1-1, Plans and Policies, box 407, entry 2, RG 428.

103. Memo, Op–50 for Op–05, 10 January 1950, sub: Directives to Material Bureaus, folder A5-A7, box 713, entry 2, RG 428. See also memo, Rear Adm. R. P. Briscoe, Director, Fleet Operational Readiness (Op–34), for Rear Adm. I. N. Kiland, 26 September 1949, sub: Directives to the Technical Bureaus through a Single DCNO, folder A3-1, Organization (General), box 411, entry 2, RG 428.

104. Department of the Navy Research and Development Board [Kendall Board], "Summary of Low Board Report on Study of Undersea Warfare," in *Abstracts of Pertinent Bibliographic Material*, 20 September 1950, 161, 164, folder A20 (597)/A9-11, box 1048, entry 1, RG 428.

105. OPNAV Instruction 0390.1 (Navy Research and Development Coordination), May 1951, cited in Booz, Allen & Hamilton, *Review of Navy R&D Management*, Vol. I, 192-93.

106. For a detailed description of the Navy's budget process as it related to funding for research and development, see ibid., 255-69. In 1949, the Office of Budget and Reports became the Office of the Comptroller.

107. Ibid., 262.

108. Aviation History Unit (Op–50D–1), "Narrative of the Bureau of Aeronautics, 1 Sept. 1945–30 Sept. 1947," 1947, 57, atch to ltr, Chief of the Bureau of Aeronautics to Director of Naval History, 13 April 1948, folder BuAer, 1946–1958, box 1, BAH Records, OAD, NHC.

109. Ibid., 57-60.

110. Ltr, Vice Adm. E. W. Mills, Chief, Bureau of Ships, to Chief of Naval Operations, 3 June 1948, sub: Progressive Carrier All-Weather Aircraft Program; and ltr, Adm. A. W. Radford, Vice

Chief of Naval Operations, to Chief of Bureau of Ships, Chief of Bureau of Aeronautics, 1 July 1948, sub: Progressive Carrier All-Weather Aircraft Program: both in folder C-CV/VZ, 48, box 28, entry 1017C (Confidential General Correspondence 1948), RG 19 (Records of the Bureau of Ships), Archives II.

111. Ltr, Adm. A. W. Radford, Vice Chief of Naval Operations, to Chief of the Bureau of Ordnance, 18 October 1948, sub: Cognizance of Material, folder S68/S75-1, box 243, entry 1, RG 428.

112. Memo, W. John Kenney, Under Secretary of the Navy, for Mr. Sullivan [Secretary of the Navy John L. Sullivan], 17 March 1949, sub: Guided Missiles Program, folder A10, A13, Pubs., Research, Hist., Inventions, 1948–1949, box 2, Sullivan Papers, RG 428. BuAer was developing two air-to-air missiles (Sparrow and Oriole), and BuOrd, one (Meteor); BuAer, one surface-to-air missile (Lark), and BuOrd, three (Talos, Terrier, Zeus); BuAer, three surface-to-surface missiles (Regulus, Rigel, and Pollux), and BuOrd, one (Triton). BuShips did not acquire missiles but maintained a keen interest in development programs because missiles, whether launched from ships or aircraft stationed on them, affected ship design and shipborne electronic systems such as radars needed for target detection, acquisition, and interception.

113. Cited in Muir, *Black Shoes and Blue Water*, 29.

114. Alfred M. Pride, interview by Peter Spectre, 12 January 1980, Arlington, Va., U.S. Naval Institute Oral History Program, 1984, 178, copy in OAB, NHC. Pride does not indicate when this meeting took place but it may have occurred soon after Under Secretary of the Navy W. John Kenney sent a memorandum to Secretary of the Navy John L. Sullivan in March 1949 that described the cognizance issues associated with the missile program. See memo, W. John Kenney for Mr. Sullivan, 17 March 1949, sub: Guided Missiles Program, folder A10, A13, Pubs., Research, Hist., Inventions, 1948–1949, box 2, Sullivan Papers, RG 428.

115. Memo, Vice Adm. J. H. Cassady, Deputy Chief of Naval Operations (Air), for Chief of Naval Operations, 28 April 1950, sub: Bureau Cognizance and Navy Department Procedures in Connection with the Guided Missiles Program, folder VV(10), box 709, entry 2, RG 428.

116. Ltr, C. E. Olsen, Senior Member, Sub-Board One, Navy Department Management Survey Board, to Distribution List, 3 April 1950, sub: Guided Missiles, Cognizance of, folder F1-1, A8, F41, F44, box 7, Op–00 Files, 1950, OAB, NHC.

117. Ibid.

118. Department of the Navy, *Research and Development Survey Board* [Kendall Board] *Progress Report*, 1 July 1950, 4-2, folder EN1 (Naval Research)/A23, box 1088, entry 1, RG 428.

119. Project Hartwell, Massachusetts Institute of Technology, "A Report on the Security of Overseas Transport," 21 September 1950, Vol. 1, 12-3, folder NC (MIT)/A9-11, box 1116, entry 1, RG 428.

120. Interim Systems Coordination Facility, Naval Research Laboratory, "A Survey of Systems Coordination," 1 May 1951, II-35, folder A11 (Systems Coordination), 13 October 1951, box 1023, entry 1, RG 428.

121. Carl H. Builder, *The Masks of War: American Military Styles in Strategy and Analysis*, 18.

122. See Vincent Davis, *The Admirals Lobby*, 10, 13, 38-41; and Hone, *Power and Change*, 5, 24-27.

123. In March 1948, Op–03's New Development Board (immediate predecessor of the Navy Research and Development Review Board) ranked the capability to attack targets with carrier-based aircraft carrying either nuclear or conventional weapons to a combat radius of 2,000 nautical miles as first in priority among the Navy's planning objectives. See encl. A (Briefs of Navy Planning Objectives) to memo, Rear Adm. Jerauld Wright, Op–03, Chairman, New Development Board, for Navy Secretary, Research and Development Board, 1 March 1948, sub: Planning Objectives, Navy Department for New Development Plan, 1950, folder A1-1, Jan.–Apr., box 177, entry 1, RG 428. Of course, as noted in the previous section, OPNAV sometimes designated more than one program for top priority development in the late 1940s.

124. Chuck Hansen, *U.S. Nuclear Weapons: The Secret History*, 121. In the gun-type weapon, a

propellant charge drives a subcritical mass of fissionable material into a target of subcritical mass of fissionable material, producing a supercritical mass, and hence the atomic explosion (p. 14).
125. Ibid., 31. In the implosion-type weapon, "a subcritical configuration . . . of fissionable material is compressed radially into a supercritical state by a centrally directed radial shock wave . . . to produce an atomic explosion" (p. 14).
126. Hansen, *U.S. Nuclear Weapons*, 122-28, 131-33, and table 4-7 (Early U.S. Nuclear Weapons & Delivery Systems), 143.
127. Ibid., 128-30, 138.
128. Hansen, *U.S. Nuclear Weapons*, 133-38. The Mark 5 also became available in 1952. It was an implosion bomb that weighed about 3,200 lbs., and was 11 feet in length and less than 4 feet in diameter. Although much lighter than the Mark III, the Mark 4, and the Mark 6, it was considered to be a small strategic weapon because it could not be carried on tactical aircraft as could the Mark 7 and the Mark 8. See ibid., 128-30.
129. Memo, Rear Adm. W. S. Parsons, Op–36, for Op–34, 10 February 1949, sub: Summary of Remarks by Op–36 for Presentation to General Eisenhower, 2 February 1949, folder A3-2, box 290, entry 1, RG 428.
130. Ltr, Chief of Naval Operations (Op–55B) to Chief, Armed Forces Special Weapons Project, 22 June 1951, sub: Aircraft Designated to Carry Atomic Bombs, folder VV/A3-ZZ, box 1125, entry 1, RG 428. Among these aircraft, with manufacturer in parentheses, were the AD–4 Skyraider (Douglas); F2H–2 and F2H–3 Banshee (McDonnell); F4U–5 Corsair (Vought); and the F7F–3 Tigercat (Grumman). The Banshee was jet-powered.
131. Jerry Miller, *Nuclear Weapons and Aircraft Carriers: How the Bomb Saved Naval Aviation*, 120-26; and Rosenberg, "Postwar Air Doctrine," 193-94.
132. Bureau of Aeronautics, "Experiments and Development, 1946, Revised Estimate," 14, 28 August 1945, box 28, entry 1025 (Research and Development Master Plans, 1946–1948), RG 72.
133. Ibid., 3. Subsequent budget cuts slashed the amount available for experimental aircraft in FY 1946 from $76 to $23 million. Nevertheless, funds for the nuclear weapons–capable aircraft prototype were only cut to $7.5 million, an indication of the project's relative importance. The only other aircraft prototype funded for FY 1946 was a night fighter in the amount of $4 million.
134. Barlow, *Revolt of the Admirals*, 132.
135. Ibid., 132-34. Sallada's 11 December 1945 memorandum to the CNO appears in Friedman, *U.S. Aircraft Carriers*, 231-32.
136. Two major restrictions would affect aircraft in the 45,000-lb. class operating from the three *Midway*-class carriers. First, the aircraft would be too large for their elevators. Therefore it could not be "struck" (stowed) below the flight deck on the hangar deck. Second, although the aircraft would be able to take off, it would be too heavy to land on the carrier. The desired landing weight for an aircraft in this weight class was 29,000 lbs. See Friedman, *U.S. Aircraft Carriers*, 231; and memo, Capt. C. A. Nicholson, Assistant Chief, RD&E, Bureau of Aeronautics, for Chief, Bureau of Aeronautics, 3 June 1946, sub: Model VA Airplane, Design Competition, Recommendation, folder Day Copies, 3 June 1946–15 June 1946, box 2, entry 69, RG 72.
137. Friedman, *U.S. Aircraft Carriers*, 231.
138. Development of the aircraft, designated the XA2J–1, began in FY 1948 under a contract with North American. It first flew in January 1952, but never went into production.
139. Barlow, *Revolt of the Admirals*, 135; and Friedman, *U.S. Aircraft Carriers*, 233.
140. Memo, Nicholson for Chief, Bureau of Aeronautics, 3 June 1946. For a detailed description of the specifications desired for the aircraft (but an account that does not identify the sources used by the author), see William E. Scarborough, "The North American AJ Savage, Part One: Establishing the Heavy Attack Mission," *The Hook* 17, no. 3 (Fall 1989): 31.

141. George Spangenberg, interview by Capt. Rosario Rausa, USN (Ret.), 18 July 1990, Pensacola, Fla., tape 7 of 16, side A, p. 3. (The interview was conducted under the auspices of the Naval Aviation Museum Foundation; a copy is also available in the Naval Historical Center, Washington, D.C.) See also Miller, *Nuclear Weapons and Aircraft Carriers*, 92-93, 273 (note 21).
142. Memo, Nicholson for Chief, Bureau of Aeronautics, 3 June 1946.
143. NAVAER Contract Record for NOA (S) Contract No. 8348, box 14, entry UD 90 (Contract Records; Record Cards for Contracts, 1940–1959), RG 72. The value of the contract was $12,098,857. Although only $7.5 million had been budgeted for the prototype, the bureau chief possessed authority to reprogram appropriated funds.
144. By June 1946, BuAer had begun to consider that the aircraft might be employed in combat. To increase the combat radius to 700 nm, BuAer proposed to add wingtip drop tanks. See memo, Nicholson for Chief, Bureau of Aeronautics, 3 June 1946.
145. Scarborough, "Establishing the Heavy Attack Mission," 31. This article, and its sequel, "The North American AJ Savage, Part II, Launching the Heavy Attack Mission," *The Hook* 17, no. 4 (Winter 1989): 16-33, are the most thorough accounts available of the AJ–1's acquisition and service with the fleet. From 1949 to 1951, Scarborough flew the AJ–1 while assigned to VC–5, the Navy's first heavy attack, nuclear weapons–equipped squadron.
146. Barlow, *Revolt of the Admirals*, 134. Barlow bases his conclusion, in part, on the recollection, contained in an oral history interview conducted in 1984, of the officer who drafted the 11 December 1945 memorandum from Admiral Sallada to the CNO that outlined the proposed heavy attack program. He also notes that an official description of the XAJ–1 in July 1946 indicated that the aircraft would be able to take off from a carrier with an 8,000-lb. bomb load, a payload presumably insufficient for either the Little Boy–Type bomb, which weighed 8,900 lbs., or the Fat Man–Type at 10,300 lbs.
147. Friedman, *U.S. Aircraft Carriers*, 244. ("It is no longer clear whether the Savage was conceived from the beginning as a nuclear bomber.")
148. The following evidence supports the view that the AJ–1 was intended from the outset to carry the atomic bomb. BuAer's budget for FY 1946 set aside funds for an experimental prototype that could carry the atomic bomb. The only other funds provided for an experimental prototype in the budget were for a night fighter. [Bureau of Aeronautics, "Experiments and Development, 1946, Revised Estimate," 14, 28 August 1945, box 28, entry 1025 (Research and Development Master Plans, 1946–1948), RG 72.] Early in October 1945, BuAer's Aviation Design Research Branch prepared a preliminary study of an attack aircraft able to carry a 7,000-lb. bomb load. In commenting on the study, an officer in BuAer noted: "It is desired to emphasize that firm requirements regarding this plane cannot be given due to the lack of information on form factors, weight and operational characteristics of the payload." Additionally, the officer remarked that the aircraft must be designed to ensure "accessibility to the payload to permit adjustment in flight." These comments almost certainly refer to an atomic bomb. The officer lacked information on the weight and dimensions of the payload but knew that the bomb would have to be armed in flight. (This was the job performed by Capt. William S. Parsons, weaponeer on the Hiroshima mission, and Cdr. Frederick L. Ashworth, weaponeer on the Nagasaki mission. After the war, both were assigned to the staff of the Special Weapons Division in the Office of the Chief of Naval Operations, Op–06, established in November 1945.) [Memo, Capt. R. E. Dixon for Captain Lonnquest, 31 October 1945, and memo, Capt. A. Hyatt, Aviation Design Research Branch, Bureau of Aeronautics, for Director of Engineering, Bureau of Aeronautics, 12 October 1945, sub: Preliminary Study of Carrier Bombardment Type Designed to Carrier Limiting Conditions: both in folder VB, box 365, entry 67A (Records of Divisions and Offices; Office Services Division, Central Correspondence; Confidential Correspondence, 1922–1947), RG 72.] A 23 April 1946 letter from Rear Admiral Sallada to the Deputy Chief of Naval Operations for Special Weapons, Op–06, is the earliest unambiguous evidence that the AJ–1 would be designed to carry the atomic bomb and that

BuAer was aware of the weapon's approximate physical dimensions: ". . . a large carrier-based bomber is in the design competition stage and a contract will be awarded within the next two months. This aircraft will have a design gross weight of 43,000 pounds including allowance for an 8,000 to 10,000 pound bomb. As a further step in the program toward heavy carrier-based bombers, a much larger aircraft . . . [has been] . . . approved for further study. . . . The gross weight of the aircraft including allowance for one 8,000/10,000 bomb is expected to be about 90,000 pounds. . . . *Detailed information concerning the bomb installation characteristics will be required in the near future for use in connection with both of these projects*. This need is particularly critical in connection with the intermediate 43,000 pound bomber, on which detailed design and construction work will commence in the very near future." Ltr, Rear Adm. H. B. Sallada, Chief, Bureau of Aeronautics, to Chief of Naval Operations (DCNO Special Weapons), 23 April 1946, sub: Atomic Energy Developments, Bureau of Aeronautics Liaison Concerning, folder Day Copies, 19 Apr. 1946–30 Apr. 1946, box 1, entry 69, RG 72 [italics added]. In an interview conducted in 1969, Ashworth confirms the view that BuAer was aware of the *Fat Man* bomb's general dimensions: "So we arranged for Murphy [Capt. J. N. Murphy] and myself to go out to North American and actually look at a mock up of the airplane and do some measuring. It was so close that it either would just fit or would not quite fit, that sort of thing." Ashworth then provided precise specifications for the bomb and instructions for installing it in the bomb bay. [Vice Adm. F. L. Ashworth, interview by A. B. Christman, 9 and 10 April 1969, Naval Weapons Center, China Lake, Calif., 63-64, box 868, Oral History Collection, Archives of the Navy Laboratory Center Coordinating Group, 1940s–1990s, OAB, NHC. See also, Miller, *Nuclear Weapons and Aircraft Carriers*, 91-92.]

149. NAVAER Contract Record for NOA (S) Contract No. 9243, box 18; and NAVAER Contract Record for NOA (S) Contract No. 9773, box 20: both in entry UD 90 (Contract Records; Record Cards for Contracts, 1940–1959), RG 72. On 26 September 1949, North American received a third production contract for 15 more aircraft. See NAVAER Contract Record for NOA (S) Contract No. 10486, box 24, ibid. The value of each of the production contracts was, respectively, $16,512,064, $24,623,138, and $12,844,982. North American manufactured a total of 143 AJs: 3 XAJ–1s, 55 AJ–1s, 30 AJ–2Ps (a photo reconnaissance aircraft), and 55 AJ–2s (an improved AJ–1). See Scarborough, "Establishing the Heavy Attack Mission," 38, 40.

150. Memo, Capt. C. A. Nicholson, Assistant Chief for Design and Engineering, Bureau of Aeronautics, for Research and Development Group, Design and Engineering Group, R.D.D&E. Memorandum 24-48, 23 September 1948, sub: Experimental Piloted Aircraft Contracts Policy, folder R&D Memoranda, 1947, 1948, box 1, entry 198 (Research and Development Memoranda, 1943–1948), RG 72.

151. Scarborough, "Establishing the Heavy Attack Mission," 37, and "Launching the Heavy Attack Mission," 16; and Miller, *Nuclear Weapons and Aircraft Carriers*, 94-95. Miller attributes the decision to carry out flight testing concurrently in the unit and at Patuxent River directly to VC–5's commanding officer: "Hayward received considerable criticism for taking this approach, but politics plays a big role in the ability of the services to remain viable, and this was a serious challenge to the Navy. It is difficult to predict what might have happened to naval aviation had Hayward not taken the short-cut approach. The nuclear mission was the only game in town, and the Navy had to get into it."

152. Miller, *Nuclear Weapons and Aircraft Carriers*, 95.

153. Scarborough, "Establishing the Heavy Attack Mission," 32-33, 37.

154. Scarborough, "Launching the Heavy Attack Mission," 32.

155. Alfred M. Pride, interview by Peter Spectre, 12 January 1980, Arlington, Va., U.S. Naval Institute Oral History Program, 1984, 214-15, copy in OAB, NHC.

156. Scarborough, "Establishing the Heavy Attack Mission," 37. In an article published in 1981, Hayward, VC–5's first commanding officer, acknowledged the aircraft's numerous problems but did not offer any explanation for them. See John T. Hayward, "The Atomic Bomb Goes to Sea,"

The Hook 9, no. 4 (Summer 1981): 22-27. In memoirs published almost 20 years after the article, Hayward agreed with Scarborough's assessment. See John T. Hayward and C. W. Borklund, *Bluejacket Admiral: The Navy Career of Chick Hayward*, 188.
157. Scarborough, "Launching the Heavy Attack Mission," 16, 19.
158. Chuck Hansen, "Nuclear Neptunes: Early Days of Composite Squadrons 5 & 6," *American Aviation Historical Society Journal* 24, no. 4 (Winter 1979): 263-65. The P2Vs were hoisted aboard the carriers by crane when the ships were docked. Following completion of an actual nuclear strike, the Neptunes would have landed at a shore base or would have ditched near the aircraft carrier or some other vessel. See Miller, *Nuclear Weapons and Aircraft Carriers*, 81, 83.
159. According to Rosenberg, the Navy achieved a "rudimentary" carrier-based, nuclear weapons delivery capability in February 1951, only after the JCS and the National Security Council had approved storing the atomic bomb's nonnuclear components aboard aircraft carriers and a system implemented for flying the nuclear components to the carriers at sea. See Rosenberg, "Postwar Air Doctrine," 192.
160. For the MiG–15, see Asher Lee, *The Soviet Air Force*, 118.
161. Ltr, Rear Adm. Thomas S. Combs, Assistant Chief, Bureau of Aeronautics [it is likely that Combs signed the letter on behalf of Rear Adm. Alfred M. Pride who became BuAer's chief on 1 May 1947], to Secretary of the Navy, sub: Project 6A (CV Flush Deck) in 1949 Shipbuilding and Conversion Program, Justification for, box 2, folder A1, Plans, Projects, and Policies, 1948–1949, Sullivan Papers, RG 428. The letter is not dated but bears Secretary of the Navy John L. Sullivan's handwritten note, dated 7 November 1947, endorsing construction of the flush-deck carrier. On 3 September 1947, Acting Secretary of the Navy W. John Kenney had approved inclusion of the carrier in the FY 1949 program. The BuAer letter may have been intended to reinforce the ship's importance to Sullivan, who succeeded Forrestal as Navy secretary on 18 September 1947.
162. Ibid. Sullivan's handwritten note on the document.
163. A careful and thoroughly documented account of the evolution of the 6A project is Barlow, *Revolt of the Admirals*, 131-45. But see also Friedman, *U.S. Aircraft Carriers*, 225-53, especially for Navy postwar carrier designs generally.
164. Barlow, *Revolt of the Admirals*, 107.
165. Friedman, *U.S. Aircraft Carriers*, 221, 244.
166. For the Essex conversions, see ibid., 288-94; and Miller, *Nuclear Weapons and Aircraft Carriers*, 186-90. Modifications to both the *Essex* and *Midway* classes were aimed primarily at accommodating the AJ–1 and nuclear weapons, but were also intended to make the older carriers suitable for jet aircraft operations generally, for example, by adding blast deflectors behind the catapults and by expanding aviation gasoline storage capacity to meet the jets' increased fuel requirements. See Thomas B. Grassey, "Retrospective: The *Midway* Class," U.S. Naval Institute *Proceedings* 112, no. 5 (May 1986): 186.
167. Barlow, *Revolt of the Admirals*, 137-41.
168. Ibid., 141-44.
169. Approved Characteristics, Project 6A (CVA, Flush Deck), 15 November 1948, encl. to ltr, Chief of Naval Operations, to Distribution List, 18 November 1948, sub: CVA (Flush Deck), Shipbuilding Project No. 6A, folder C-CVA58/S1-1, 48, box 31, entry 1017C, RG 19.
170. Ibid.; and Department of the Navy Press Release, 6 October 1948, folder CVA–58, Project 6A, Oct. 1948–21 Apr. 1948, box 3, entry 1022B (Accession 15411, Ship Hull Design History and Data Files, 1920–1968), RG 19. Maximum length (including hull and flight deck) would be 1,090 feet and maximum (fixed) beam 190 feet (deck-edge elevators would extend the width even farther). Fully loaded, the ship would displace 80,000 tons. In contrast, the *Midway* -class carriers were 900 feet in length and 113 feet in beam at the waterline (968 feet in length including deck and hull; 136 feet maximum fixed beam), and displaced 45,000 tons. The figures for the *Essex* carriers were 820 feet/888 feet in length, 93 feet/147 feet in beam, and a standard displacement of 27,000 tons. See Friedman, *U.S. Aircraft Carriers*, 394-95.

171. Approved Characteristics, Project 6A (CVA, Flush Deck), 15 November 1948, 48.
172. Ibid.
173. Draft Navy Day speech for Rear Adm. C.D. Wheelock [deputy and assistant chief of the Bureau of Ships], 15 October 1948, folder CVA–58, Project 6A, Oct. 1948–21 Apr 1949, box 3, entry 1022B, RG 19.
174. For an excellent discussion of these relationships, see the unsigned paper (evidently draft remarks) dated 13 March 1949, in folder A21/1-1, Navy Carrier, box 150, Records of Op–23 (Organizational Research and Policy Division, OPNAV), OAB, NHC.
175. Memo, Capt. J. M. Farrin, for Code 400 [assistant chief of the Bureau of Ships for ships], 20 April 1948, sub: Notes on the Size of the New Carrier (Project 6A), folder CV-, Flush Deck Aircraft Carrier, SB 49, Project 6A, Vol. 1, Sept. 1947–31 Aug. 1948, box 3, entry 1022B, RG 19; and Friedman, *U.S. Aircraft Carriers*, 394-95.
176. Ltr, Chief of Naval Operations, to Chief, Bureau of Ships, 12 August 1948, sub: Construction of an Aircraft Carrier in a Private Yard, Authority for, folder Op–04 (DCNO for Logistics), box 3, Op–00 Files, 1948, OAB, NHC.
177. For the Vinson-Trammel Act (P.L. 135, 73d Cong., 48 Stat. 503), see Aaron L. Friedberg, *In the Shadow of the Garrison State: America's Anti-Statism and Its Cold War Strategy*, 283.
178. BuShips had engaged the company to assist in preparing contract plans for the flush-deck carrier as early as April 1948. See memo, Capt. L. V. Honsinger [Code 440, BuShips Design Division] for Code 400 [assistant chief of the Bureau of Ships for ships], 7 April 1948, sub: Project 6A, Hull Contract Plans and Specifications, Participation in Preparation of Newport News; and ltr, Code 420 [BuShips Design Division] to Supervisor of Shipbuilding, USN & Naval Inspector of Ordnance, Newport News Shipbuilding and Dry Dock Co., 9 April 1948, sub: New Carrier, Shipbuilding Project 6A, Forwarding of Preliminary Plans and Information on: both in folder CV-, Flush Deck Aircraft Carrier, SB 49, Project 6A, Vol. 1, Sept. 1947–31 Aug. 1948, box 3, entry 1022B, RG 19
179. Department of the Navy Press Release, 6 October 1948.
180. Draft memo [prepared by Capt. C. M. Tooke, Code 440, Bureau of Ships Design Division], for Secretary of the Navy, 28 May 1948, sub: Large Aircraft Carrier (Project 6A), Shipbuilding and Dry Dock Facilities, folder CV-, Flush Deck Aircraft Carrier, SB 49, Project 6A, Vol. 1, Sept. 1947–31 Aug. 1948, box 3, entry 1022B, RG 19. The naval shipyards in Brooklyn, N.Y., Philadelphia, Pa., and Norfolk, Va. could have built the carrier. In addition to Newport News, BuShips thought the private yards of the Bethlehem Company in Quincy, Mass., and of the New York Shipbuilding Corporation in Camden, N.J., could have handled the vessel's construction but only after more extensive modifications than those required at the Newport News yard.
181. William E. Blewett, Jr., "*Always Good Ships*"*: A History of the Newport News Shipbuilding and Dry Dock Company*, Address before the Newcomen Society in North America, New York, N.Y., 27 October 1960, 19-21. Blewett was the company's vice president and production manager from 1941 to 1947 and executive vice-president from 1947 until 1954 when he became its president.
182. Bureau of Ships, Request for Procurement Work Sheet, 1 July 1948, folder CV-, Flush Deck Aircraft Carrier, SB 49, Project 6A, Vol. 1, Sept. 1947–31 Aug. 1948, box 3, entry 1022B, RG 19.
183. Department of the Navy, *Report of the Secretary of the Navy for Fiscal Year 1947*, 41. See also Department of the Navy, *Annual Report of the Secretary of the Navy for Fiscal Year 1948*, 34. In FY 1951, most new construction took place in private shipyards and most conversions in naval shipyards. See Semiannual Report of the Secretary of the Navy, January 1, 1951, to June 30 1951, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1950*, 160-61.
184. Blewett, "*Always Good Ships*," 21.
185. William L. Tazewell, *Newport News Shipbuilding: The First Century*, 192.

186. Memorandum No. 75-49, Capt. C. M. Tooke, Code 440 [Design Division], Bureau of Ships, for Code 400 [assistant chief of the Bureau of Ships for ships], 10 February 1949, sub: USS *United States*, Pertinent Information for Possible Use in Speeches, unlabeled folder, box 3, entry 1022B, RG 19. Another estimate was that the ship would require 9,000 "plans and blueprints." See draft Navy Day speech for Rear Adm. C. D. Wheelock, 15 October 1948.
187. Memo, Capt. C. A. Nicholson, Assistant Chief for Design and Engineering, Bureau of Aeronautics, for Research and Development Group, Design and Engineering Group, R.D.D.&E. Memorandum 24-48, 23 September 1948, sub: Experimental Piloted Aircraft Contracts Policy, folder R&D Memoranda, 1947, 1948, box 1, entry 198 (Research and Development Memoranda, 1943–1948), RG 72.
188. For the role of the supervisor of shipbuilding and the general pattern of contractual relationships between the Navy and private shipbuilders, see Gary E. Weir, *Building American Submarines, 1914–1940*, 20-22.
189. Memorandum Report of Travel, Capt. C. E. Trescott, Code 512, Bureau of Ships, 10 March 1949, unlabeled folder, box 3, entry 1022B, RG 19.
190. Ibid.
191. Ltr, Vice Adm. A. D. Price, Deputy Chief of Naval Operations for Air, to Chief of the Bureau of Aeronautics, 29 April 1949, sub: Long Range Attack Aircraft Development, folder A1-1/A11, box 632, entry 2, RG 428.
192. For the design evolution of the 100,000-lb. heavy attack aircraft and selection of the Douglas design, see Barlow, *Revolt of the Admirals*, 137, 139, 330 (note 37); memos, C. A. Nicholson, Assistant Chief for Design and Engineering, Bureau of Aeronautics, for Chief Bureau of Aeronautics, 2 February 1949, sub: Long Range, Heavy Attack Informal Design Competition, Recommendation, and 18 February 1949, sub: VA (heavy) Design Competition: both in folder VA, box 158, entry 1003A (Confidential General Correspondence, 1948–1949), RG 72; and ltr, Rear Adm. A. M. Pride, Chief, Bureau of Aeronautics, to Chief of Naval Operations, 1 June 1949, sub: Heavy Attack Airplane, XVA (H–1), Development, and ltr, Price to Chief of the Bureau of Aeronautics, 29 April 1949: both in folder A1-1/A11, box 632, entry 2, RG 428.
193. William J. Armstrong, app. 1 (Aircraft Data—Technical Information and Drawings), in Roy A. Grossnick, *Dictionary of American Naval Aviation Squadrons*, Vol. 1, *The History of VA, VAH, VAK, VAL, VAP, VFA*, 443-45. For the history of the A3D, see Bruce Cunningham, "Birth of the Douglas A3D," *American Aviation Historical Society Journal* 51, no. 3 (Fall 2006): 207-19; Cunningham, "History of the Douglas A3D Skywarrior, Part 2: A3D–1 Early Production Testing," *American Aviation Historical Society Journal* 51, no. 4 (Winter 2006): 271-88; and Cunningham, "A3D–2 Versions, Part III," *American Aviation Historical Society Journal* 53, no. 2 (Summer 2008): 135-46.
194. Barlow, *Revolt of the Admirals*, 106-07; and Rosenberg, "Postwar Air Doctrine," 178-79, 181. Commanders Ashworth and Hayward were in this group.
195. Barlow, *Revolt of the Admirals*, 106-07.
196. Although known as amtracs for most of their history, the vehicles have also been called "Alligators," "Buffaloes," and "Bushmasters." Since 1985, the Marine Corps has used the term "assault amphibious vehicle" (AAV) instead of amtrac. The best survey of the amtrac's evolution is Kenneth W. Estes, *Marines under Armor: The Marine Corps and the Armored Fighting Vehicle, 1916–2000*. See also Victor J. Croizat, *Across the Reef: The Amphibious Tracked Vehicle at War*; and Alfred Dunlop Bailey, *Alligators, Buffaloes, and Bushmasters: The History of the Development of the LVT through World War II*.
197. Amtracs also participated in operations in North Africa and Europe and were used by the Army as well the Marine Corps.
198. Both the Marine Corps and Army also employed the DUKW (pronounced "duck"), a 2½ ton truck, made buoyant by sealed, empty tanks that were part of its body. In contrast to the amtrac, the DUKW was a "floater" and had to "swim" around rather than go over barriers. Only

one letter in the acronym bore any similarity to the characteristic or function it represented: "D" stood for the year 1942; "U" for utility vehicle; "K" for four-wheel drive; and "W" for two, rear-driving axles.

199. When the program began, the two vehicles were designated the LVT–5 and the LVT(A)6. In the fall of 1952, BuShips changed LVT nomenclature. For simplicity's sake, I have used the designations that were adopted at that time—LVTP–5 and LVTH–6. For the LVT redesignations, see ltr, Chief, Bureau of Ships, to Distribution List, 29 October 1951, sub: Landing Vehicle, Tracked (LVT); Revised Nomenclature List for, folder LVT/S28, 1952, box 4, entry 1006 (Unclassified Central Correspondence, 1952; Miscellaneous Boxes Containing File Category "L"), RG 19.

200. Millett, *Semper Fidelis*, 452-56, 464; and Estes, *Marines under Armor*, 118, 132-33.

201. Ltr, Op–414 (F. L. Hoffheins, Fleet Maintenance) to Op 41, 18 September 1950, sub: Current Major Projects in Op–414, 6-7, folder EN3P, box 1091, entry 1, RG 428; memorandum for file, LCdr. J. W. Schiffel, Code 518D, Bureau of Ships, 5 February 1951, sub: LVT Production Program, folder LVT/A9, 1951, box 687, entry 1005 (Unclassified Central Correspondence, 1951), RG 19 [hereafter Schiffel memorandum, 5 February 1951]; and Ingersoll Kalamazoo Division, Borg-Warner Corporation, "Research, Investigation & Experimentation in the Field of Amphibian Vehicles for United States Marine Corps, Contract 66245, Final Report," December 1957, 103-26, box 4, entry 28 (Headquarters Support Central Files, Subject Correspondence Files, 1 Jul. 1950–31 Dec. 1958), RG 127 (Records of the United States Marine Corps), Archives II [hereafter Borg-Warner report]. Other vehicles in the new "family" of LVTs were a command vehicle and several cargo-only carriers.

202. Schiffel memorandum, 5 February 1951; and Estes, *Marines under Armor*, 112

203. Memorandum for file, Capt. L. V. Honsinger, Code 506, Bureau of Ships, 17 December 1952, sub: LVT Construction Programs; Production Progress Report as of 15 December 1952, folder C-LVT/A1-1, 1952, box 167, entry 1017G1 (Confidential General Correspondence, 1952), RG 19; and memorandum for file, Capt. L. V. Honsinger, Code 506, Bureau of Ships, 10 June 1953, sub: LVT Program; Production Progress Report as of 8 June 1953, folder C-LVT/L4-3, 1953, entry 1017H1 (Confidential General Correspondence, 1953), RG 19.

204. Estes, *Marines under Armor*, 112, 234 (note 9).

205. Ibid., 139-44; Bailey, *Alligators, Buffaloes, and Bushmasters*, 248; and R. P. Hunnicutt, *Bradley: A History of American Fighting and Support Vehicles*, 368-69 (photographs). Fifty LVT–3Cs made it to Korea in time to participate in the Inchon landing.

206. After World War II, a section was established in the Division of Plans and Policies at Marine Corps headquarters to coordinate Marine Corps research and development activities. In 1952, the Marine Corps adopted a general staff organization. The Division of Plans and Policies was abolished and the R&D section became a branch of the newly created G–4 Division. In 1956, research and development assumed increased importance at headquarters with the creation of a deputy chief of staff for research and development. See Kenneth J. Clifford, *Progress and Purpose: A Developmental History of the United States Marine Corps, 1900–1970*, 91-93.

207. Ltr, Frank Knox, Secretary of the Navy, to Chief of the Bureau of Ships, Commandant of the Marine Corps, 30 October 1943, sub: Continuing Board for the Development of Landing Vehicles, Tracked, for Use in Amphibious Operations, encl. to ltr, Adm. Forrest Sherman, Chief of Naval Operations, to Secretary of the Navy, 26 May 1950, sub: Landing Vehicle, Tracked (LVT (3)): Modernization Program, folder S, Ships, General, Jan.–May 1950, box 5, Formerly Classified Correspondence of Secretary Francis P. Matthews, 1949–1950 [hereafter Matthews Papers], RG 428.

208. "The National Security Act of 1947—26 July 1947," in *The Department of Defense: Documents on Establishment and Organization, 1944–1978*, ed. Alice C. Cole, Alfred Goldberg, Samuel A. Tucker, and Rudolph Winnacker, 42.

209. Department of the Navy, *Abstracts of Pertinent Bibliographic Material: Research and Development Survey Board* [Kendall Board], 20 July 1950, 82, folder A20 (597)/A9-11, box

1048, entry 1, RG 428.

210. Ltr, Sherman to Secretary of the Navy, 26 May 1950.

211. Memo, Col. C. O. Bierman, G–4, Headquarters, USMC, for Director, Division of Plans and Policies, Headquarters, USMC, 15 August 1950, sub: LVT Development Program, folder X27, Tanks; Amphibian Vehicles, Tracked, Combat, 1 Jul. 1950–15 Mar. 1951, box 191, entry 102 (Headquarters Support Correspondence, 1950–1958), RG 127.

212. Ltr, Francis P. Matthews, Secretary of the Navy, to Commandant of the Marine Corps via Chief of Naval Operations, 2 October 1950, sub: Change in Budgetary Procedures for Marine Corps Procurement of Landing Vehicles, Tracked, and ltr, Adm. Forrest Sherman (First Endorsement on Comdt MarCorps conf ltr serial (04A22950) over AO-4-re of 22 Aug 50), to Secretary of the Navy, 30 September 1950: both in folder SecNav Classified Serials, Sept.–Dec. 1950, box 6, Matthews Papers, RG 428; and ltr, Gen. C. B. Cates, Commandant of the Marine Corps, to Chief of Naval Operations, 17 July 1951, sub: Chief of Naval Operations Annual Report for the Period 1 July 1950 through 30 June 1951, enclosing Marine Corps portion of report, folder EN3/A to EN3Z, box 1089, entry 1, RG 428. One consequence of assigning the Marine Corps budgetary responsibility for LVTs was that the vehicles were no longer included in the annual Shipbuilding and Conversion Program formulated by the Ship Characteristics Board and reviewed by the General Board.

213. For the disagreement over this question, see ltr, Gen. C. B. Cates, Commandant of the Marine Corps, to Chief of Naval Operations, 2 February 1950, sub: Modernization of Marine Corps LVT (3), and ltr, Gen. C. B. Cates, Commandant of the Marine Corps (First Endorsement on BuShips conf ltr 401-03 of 15 Feb 1950), to Chief of Naval Operations, 23 March 1950, sub: Modernization of Marine Corps Amphibious Vehicles: both in folder S, Ships, General, Jan.–May 1950, box 5, Matthews Papers, RG 428; memorandum for file, Code 518, Bureau of Ships, 10 December 1951, sub: Proposed Food Machinery and Chemical Corporation Specifications for 45,000 lb. LVT, folder LVT/S1-4, 1951, box 689, entry 1005, RG 19; Rear Adm. E. W. Sylvester, Assistant Chief of the Bureau of Ships for Ships, Memorandum Report of Conference Held at 0900, 8 January 1953, Room 3033, Main Navy Building, folder C-LVT/L4-3, 1953, box 155, entry 1017 H1, RG 19; memorandum for discussion [with Rear Admiral Sylvester], Brig. Gen. H. L. Litzenberg, USMC, Senior Member, LVT Continuing Board, 9 March 1953, folder C-LVT/S1-1, 1953, box 155, entry 1017 H1, RG 19; and ltr, Chief of Staff, Headquarters, USMC, to Assistant Chief of Staff, G–4, Headquarters, USMC, 6 August 1954, LVT Matters, folder X27, Vehicles, Tracked, Combat, 1 Jul. 1954–15 Sept. 1954, box 192, entry 102, RG 127.

214. Estes, *Marines under Armor*, 153.

215. Ltr, Chief, Bureau of Ships, to Senior Member, Continuing Board for the Development and Modernization of Landing Vehicles, Tracked, for use in Amphibious Operations, 7 March 1951, sub: LVT and LVT (A); Machinery and Armament for, folder C-LVT/S40, 1951, box 144, entry 1017F (Confidential General Correspondence, 1951), RG 19; memo, Cdr. K. A. Ayers, Code 518, Bureau of Ships, for Admiral Wallin [Rear Adm. Homer N. Wallin, chief, Bureau of Ships], 14 December 1951, sub: Production of LVT at Borg-Warner, Kalamazoo, Michigan, folder C-LVT/A1-1, 1952), box 167, entry 1017G1, RG 19; and ltr, Assistant Chief of Staff, G–4, Headquarters, USMC, to Chief of Staff, Headquarters, USMC, 10 August 1953, LVT Production Program, folder X27, Vehicles, Tracked, Combat, 1 Aug. 1953–30 Nov. 1953, box 191, entry 103, RG 127. The CNO approved the LVT Continuing Board's recommendations on 12 March 1951, followed by the secretary of the Navy on 16 April 1951 (Ayers memorandum).

216. App. B (Experience under Contracts 2716, 2723, and 2750 for LVTs) to McKinsey & Company Management Consultants, *Expediting the Procurement of Material, Department of the Navy*, Vol. II, April 1952, B–1 [hereafter McKinsey report], copy in NDU Library. In January 1952, the secretary of the Navy asked McKinsey and Company to analyze the reasons for delays in four of the Navy's major acquisition programs. In addition to the LVTP–5 and LVTH–6, the other programs were the Grumman F9F jet aircraft, mounts for 3 in./50 caliber antiaircraft

guns, and ammunition for that weapon.
217. Ltr, Rear Adm. W. D. Leggett, Jr., Deputy and Assistant Chief, Bureau of Ships, to Commandant of the Marine Corps, 4 June 1952, sub: LVT Production Program; Request for Additional Funds, folder C-LVT/L1-1, 1952, box 167, entry 1017G1, RG 19.
218. Memo for file, Assistant Supervisor of Shipbuilding, Kalamazoo, 29 May 1951, sub: LVT Inspection Meeting of 21 May 1951, folder LVT/A19, 1951, box 687, entry 1005, RG 19.
219. The Navy employed multiple contractors for other shipbuilding programs before and during the Korean War. Between October 1949 and February 1950, two of the *Mitscher*-class destroyers were laid down by Bath Iron Works in Bath, Maine, and two by the Bethlehem yard in Quincy, Massachusetts. See Muir, *Black Shoes and Blue Water*, 59. During the Korean War, Bath was made lead yard for a program to build fifteen new LSTs (Landing Ships, Tank). Five were built in Bath and the remainder in two other private yards. The first LST was designed and built in sixteen months. See Garnett Laidlaw Eskew, *Cradle of Ships*, 243. As military spending declined after World War II, multiple contracting was used to keep the private shipbuilding industry alive. During the rearmament following the start of the Korean War, the practice helped ensure that sufficient manufacturing capacity would be available should full mobilization be required. In both periods, using multiple contractors also made sense politically.
220. Schiffel memorandum, 5 February 1951; and ltr, Resident Supervisor of Shipbuilding, USN, Kalamazoo, Michigan, to Chief, Bureau of Ships, via Supervisor of Shipbuilding, USN, Chicago, Illinois, 10 September 1953, sub: Central Design Contracts for LVT Vehicles, Work Load at the Ingersoll Products Division of Borg-Warner Corporation, folder LVT/L4-3, vol. 8, from 9/17/53, box 2, entry 1007 (Unclassified Central Correspondence, 1953; Miscellaneous Boxes Containing File Category "L"), RG 19.
221. Memo, Brig. Gen. G. C. Thomas, President, Marine Corps Equipment Board and Senior Member, LVT Continuing Board, for Director of Plans and Policies, Headquarters, USMC, 14 August 1950, sub: LVT Development Program, folder X27, Tanks; Amphibian Vehicles, Tracked, Combat, 1 Jul. 1950–15 Mar. 1951, box 191, entry 102, RG 127; and ltr, Col. W. W. Davies, LVT Liaison Officer, to Commandant of the Marine Corps, 28 March 1951, sub: Report of Status of LVT Program, folder X27, Tanks; Amphibian Vehicles, Tracked, Combat, 16 Mar. 1951–15 Apr. 1951, box 191, entry 102, RG 127. The Marine Corps LVT Liaison Office, headed by Colonel Davies, was located at Camp Pendleton, the Marine Corps base at Oceanside, California. Marine Corps officers assigned to BuShips and OPNAV also followed LVT matters.
222. McKinsey report, B–4-5.
223. Schiffel memorandum, 5 February 1951.
224. McKinsey report, B–4-6 (quoting extensively from a letter by Capt M. H. Gluntz of BuShips, dated 25 October 1950); and ltr, Rear Adm. W. D. Leggett, Jr., Deputy and Assistant Chief, Bureau of Ships, to P. L. Davies, President, Food Machinery and Chemical Corporation, 10 April 1951, folder LVT/L4-3, 1951, box 688, entry 1005, RG 19. Other factors cited by the Navy were Ingersoll's excellent record in LVT development and production; the company's ability to tap the resources of Borg-Warner, its parent corporation; and the large number of automotive engineers and designers in the Detroit, Michigan area.
225. Ltr, Paul L. Davies, President, Food Machinery and Chemical Corporation, to Rear Adm. Homer N. Wallin, Chief, Bureau of Ships, 7 March 1951; ltr, Paul Davies to Chief, Bureau of Ships, 10 March 1951, sub: Design and Production of Landing Vehicles, Tracked (LVT); ltr, Wallin to Paul Davies, 10 April 1951; ltr, Paul Davies to Rear Adm. W. D. Leggett, Jr., Deputy and Assistant Chief, Bureau of Ships, 18 April 1951; and ltr, Leggett to Paul Davies, 7 May 1951: all in folder LVT/L4-3, 1951, box 688, entry 1005, RG 19; Rear Adm. H. N. Wallin, Memorandum Report of Conference, 8 May 1951, sub: LVT Production and Development Program, folder LVT/S1-1, 1951, box 688, entry 1005, RG 19; and memo for file, Rear Adm. W. D. Leggett, Jr., 26 May 1952, LVT Procurement, Conference Held in Office of the Deputy and Assistant Chief of Bureau, 23 May 1952, folder LVT/L4-3, 1952, box 2, entry 1006, RG 19.

226. Schiffel memorandum, 5 February 1951; McKinsey report, B–1; and ltr, Leggett to Commandant of the Marine Corps, 4 June 1952.
227. Memo for file, LCdr. J. W. Schiffel, Code 518D, Bureau of Ships, 2 February 1951, sub: Proposed LVT Production Schedule, folder C-LVT/A1-1, 1951, box 143, entry 1017F, RG 19; and ltr, Rear Adm. E. W. Sylvester, Assistant Chief for Ships, Bureau of Ships, to Chief of Naval Material via Commandant of the Marine Corps, 3 March 1951, sub: Landing Vehicles, Tracked; Production Schedule for, folder C-LVT/L4-4, 1951, box 144, entry 1017F, RG 19.
228. Quarterly Program Status Report, LVT Program [sic, Progress] Conference, 10 October 1955, encl. to ltr, Chief Bureau of Ships to Supervisor of Shipbuilding, USN, and Naval Inspector of Ordnance, Chicago, Illinois [et al.], 22 September 1955, sub: LVT Program, Quarterly Program Status Report of the Bureau of Ships Production Progress Conference of 10 October 1955, folder LVT/L4, vol. 3 from 7/11/55, box 2, entry 1009 (Unclassified Central Correspondence, 1955; Miscellaneous Boxes Containing File Category "L"), RG 19. The following are production figures for the original four contractors and the St. Louis Car Company, which received one of the later production contracts: Ingersoll, 237 LVTP–5s and 173 LVTH–6s; Baldwin-Lima-Hamilton, 91 LVTP–5s; Food Machinery and Chemical Corporation, 313 LVTP–5s; Pacific Car & Foundry, 56 LVTP–5s and 35 LVTH–6s; and St. Louis Car Company, 425 LVTP–5s. For the program cost, see ltr, Assistant Chief of Staff, G–4, to Commandant of the Marine Corps, 29 July 1954, sub: Status of LVT Production Program, folder X27, Vehicles, Tracked, Combat, 1 Jul. 54–15 Sept. 1954, box 192, entry 102, RG 127. The source gives $363 million as the total program expenditures. This figure included the cost for 1,119 LVTP–5s, 208 LVTH–6s, and 51 LVT recovery vehicles (for dealing with immobilized LVTs), but did not identify the cost breakdown among the three. In February 1953, the cost of each recovery vehicle was estimated to be about $261,000 for a total of approximately $13.3 million. (See memo for file, Cdr. John M. Duke, Code 518, Bureau of Ships, 17 February 1953, sub: LVT Production and Procurement, folder X27, Tanks; Amphibians, Vehicles, Tracked, Combat, 1 Sept. 1952–31 Mar. 1953, box 191, entry 102, RG 127.) The $350 million approximate cost of the LVTP–5s and LVTH–6s was arrived at by subtracting the $13 million cost of the recovery vehicles from the total program cost of $363 million.
229. The following were sources for performance characteristics: Borg-Warner report, December 1957, 127-33, 430-31; Bailey, *Alligators, Buffaloes, and Bushmasters*, 254; Hunnicutt, *Bradley*, 462-63; and Norman Friedman, *U.S. Amphibious Ships and Craft: An Illustrated Design History*, 301. Both the LVTP–5 and LVTH–6 had the same length and width—29 ft., 8 in. by 11 ft., 8½ in. Their heights differed: the LVTP–5 was 10 ft., 3in. tall; the LVTH–6, 13 ft., 4 in.
230. McKinsey report, B–6.
231. Memo for file, LCdr. J. W. Schiffel, Code 518D, Bureau of Ships, 2 February 1951, sub: Proposed LVT Production Schedule, folder C-LVT/A1-1, 1951, box 143, entry 1017F, RG 19.
232. Ltr, Cdr. K. A. Ayers, Code 518, Bureau of Ships, to Distribution List, 10 April 1952, sub: Status of Code 518 LVT Development and Production Projects, folder C-LVT/A1-1, 1952, box 167, entry 1017G1, RG 19.
233. Ltr, Cdr. K. A. Ayers, Code 518, Bureau of Ships, to Distribution List, 10 June 1952, sub: Status of Code 518 LVT Development and Production Projects, ibid.
234. Ltr (First Endorsement on CO 3d AmTracBn ltr of 1Oct53), Wilburt S. Brown, Commanding General, Force Troops, Fleet Marine Force, Pacific, to Commandant of the Marine Corps, 2 October 1953, sub: LVTP–5 Field Service Test, Final Report of; and ltr (First Endorsement on Sr Mbr LVT(P)5 AccelServTestProjBd ltr 4/WCS: glg over A9-10/2 of 26Sept53), F. B. Loomis, Jr., Commanding General, Force Troops, Fleet Marine Force, Atlantic, to Commanding General, Fleet Marine Force, Atlantic, 26 September 1953, sub: Accelerated Service Test of LVT(P)5, Final Report of: both in folder LVT/L4-3, vol. 8, from 9/17/53, box 2, entry 1007, RG 19.
235. Ltr, Cdr. K. A. Ayers, Code 518, Bureau of Ships, to Distribution List, 10 July 1952, sub:

Status of Code 518 LVT Development and Production Projects, folder C-LVT/A1-1, 1952, box 167, entry 1017G1, RG 19.
236. Ltr, Chief, Bureau of Ships to Commander, Mare Island Naval Shipyard [et al.], 5 March 1954, sub: LVT Program, Quarterly Program Status Report of the Bureau of Ships Production Progress Conference of 15 March 1954, folder LVT/L4-3, vol. 1, 1954, box 1, entry 1008 (Unclassified Central Correspondence, 1954; Miscellaneous Boxes Containing File Category "L"), RG 19.
237. Ltr, Commandant of the Marine Corps to Commanding General, Fleet Marine Force, Atlantic, 23 September 1955, sub: Operational and Tactical Testing of the LVTH–6, folder X-27, Vehicles, Tracked, Combat, 13 Sept. 1955–15 Oct. 1955, box 192, entry 102, RG 127; Estes, *Marines Under Armor*, 154; and Friedman, *U.S. Amphibious Ships and Craft*, 301.
238. Ltr, Paul L. Davies, President, Food Machinery and Chemical Corporation, to Rear Adm. Homer N. Wallin, Chief, Bureau of Ships, 7 March 1951, folder LVT/L4-3, 1951, box 688, entry 1005, RG 19; and Bailey, *Alligators, Buffaloes, and Bushmasters*, 57, 59, 61, 86, 90-91.
239. Ltr, DCNO (Air) to Distribution List, 3 March 1950, sub: Informal Conference to Discuss Desirable Characteristics for New Carrier Construction, folder A2-A4-2, box 712, entry 2, RG 428.
240. Friedman, *U.S. Aircraft Carriers*, 414; and the Deployment History section of the USS *Forrestal* Museum, Inc. website, http://forrestal.org/fidfacts/page10.htm (retrieved 8 August 2011).
241. Ltr, Assistant Supervisor of Shipbuilding, Kalamazoo, Michigan, to Ingersoll Products Division, Kalamazoo, Michigan, 8 August 1951, Contracts Nobs-2750 and Nobs-2716, Ingersoll Products Division, Contractor; LVT(5) and LVT(A)6, Procurement Bottlenecks, folder LVT/L-4, 1951, box 687, entry 1005, RG 19; and McKinsey report, B–14-15.
242. Schiffel memorandum, 5 February 1951; and Report by Mr. Howard B. Lewis to the Chief of Naval Material on Review of Present LVT Program, undated (but 1952, prior to 19 September), 2, encl. to ltr, Rear Adm. E. W. Sylvester, Deputy Chief and Assistant Chief, Bureau of Ships for Ships to Code 100 [chief, Bureau of Ships], 19 September 1952, sub: Investigation of the LVT Program by Chief of Naval Material, folder C-LVT/A1-1, 1952, box 167, entry 1017G1, RG 19 [hereafter Lewis report].
243. McKinsey report, B–3; and Lewis report, 2.
244. Ltr, Col. W. W. Davies, LVT Liaison Officer, to Commandant of the Marine Corps, 28 March 1951, sub: Report of Status of LVT Program, folder X27, Tanks; Amphibian Vehicles, Tracked, Combat, 16 Mar. 1951–15 Apr. 1951, box 191, entry 102, RG 127.
245. Lewis report, 3.
246. Ltr, Chief, Bureau of Ships, to Supervisor of Shipbuilding, USN, and Naval Inspector of Ordnance, Chicago, Illinois [et al.], 19 December 1955, sub: LVT Program, Quarterly Program Status Report of the Bureau of Ships Production Progress Conference of 9 January 1956, folder LVT/L4, vol. 4, from 10/12/55, box 2, entry 1009, RG 19.
247. Memorandum for file, Capt. L. V. Honsinger, Code 506, Bureau of Ships, 1 October 1952, LVT Construction and Modernization Programs; Production Progress Report as of 22 September 1952, folder LVT/L9-2, 1952, box 2, entry 1006, RG 19; memorandum for file, Capt. L. V. Honsinger, Code 506, Bureau of Ships, 13 March 1953, sub: LVT Construction Programs, Production Progress Report of 9 March 1953, folder C-LVT/A1-1, 1953, box 154, entry 1017H1, RG 19; ltr, Commandant of the Marine Corps to Chief, Bureau of Ships, 20 April 1953, sub: Tentative List of Corrections Required in LVTP–5, folder X27, Vehicles, Tracked, Combat, 1 Apr. 1953–31 May 1953, box 191, entry 102, RG 127; ltr, Commandant of the Marine Corps to Chief, Bureau of Ships, 9 July 1953, sub: Modifications Required for LVTP–5, folder LVT/S3, 1953, box 4, entry 1007, RG 19; ltr, Commandant of the Marine Corps to Chief, Bureau of Ships, 17 September 1953, sub: Modifications Required for LVTP–5 and Recommendations thereto, folder LVT/L4-3, vol. 8, from 9/17/53, box 2, entry 1007, RG 19; ltr, Col. S. L. Stephan, Senior Member, LVTP–5 Modification Committee, to Commandant

of the Marine Corps, 6 November 1953, sub: Modifications Required for LVTP–5 and Recommendations thereto, folder X27, Vehicles, Tracked, Combat, 1 Aug. 1953–30 Nov. 1953, box 191, entry 102, RG 127; ltr, Commandant of the Marine Corps to Chief, Bureau of Ships, 5 March 1954, sub: Modifications Required for LVTP–5 and Recommendations thereto, folder X27, Vehicles, Tracked, Combat, 1 Jan. 1954–31 Mar. 1954, box 192, entry 102, RG 127; and ltr, Chief, Bureau of Ships to Commandant of the Marine Corps, 12 July 1954, sub: Changes and Modifications for LVTH–6, folder X27, Vehicles, Tracked, Combat, 1 Jul. 1954–15 Sept. 1954, box 192, entry 102, RG 127.

248. Ltr, Col. S. L. Stephan, Marine Corps LVT Liaison Officer, to Commandant of the Marine Corps, 10 March 1953, sub: LVTP–5 Modification Center, folder X27, Vehicles, Tracked, Combat, 1 Sept. 1952–31 Mar. 1953, and ltr, Quartermaster General of the Marine Corps to Commanding General, Marine Corps Depot of Supplies, San Francisco, 26 May 1953, sub: LVTP–5 Modification, folder Vehicles, Tracked, Combat, 1 Apr. 1953–31 May 1953: both in box 191, entry 102, RG 127.

249. Annex A, p. A-5, to G–4 Division, Headquarters, USMC, Staff Study No. 4-63 (LVT Program Management), 26 November 1963, encl. to ltr, Commandant of the Marine Corps to Coordinator, Marine Corps Landing Force Development Activities, 26 November 1963, sub: LVT Program Management, folder 8410, Landing Vehicles, Tracked, box 19, entry 67 (Correspondence Files of the Office of the Commandant and Headquarters Support Division, Central Files Section, 1930–1975), RG 127 [hereafter G–4 Staff study].

250. Ltr, Roy C. Ingersoll to Raymond H. Fogler, Assistant Secretary of the Navy, 9 July 1954, folder LVT/L4-3, vol. 4, from 8/16/54, box 2, entry 1008, RG 19. See also McKinsey report, B–2.

251. Early in 1953, modification costs were estimated to be approximately $25,000 per vehicle (or about $8,750,000 for the first 350 vehicles). See memo for file, Cdr. John M. Duke, Code 518, Bureau of Ships, 17 February 1953, sub: LVT Production and Procurement, folder X27, Tanks; Amphibians, Vehicles, Tracked, Combat, 1 Sept. 1952–31 Mar. 1953, box 191, entry 102, RG 127.

252. The per unit cost of the modified LVT–3 (the LVT–3C) was $120,000. The cost of the World War II LVTs ranged from $20,000 to $24,000 each. See ltr, Chief, Bureau of Ships to Chief of Naval Operations, 15 January 1951, sub: Fiscal Year 1951 Shipbuilding Program, LVT(A) and LVT, Estimated Cost of, folder C-LVT/A1,1951, box 143, entry 1017F, RG 19; Tank, LVT, and Antimechanized Defense Section, Division of Plans and Policies, Headquarters, U.S. Marine Corps, "Comparison of LVT (3)(C) and LVT (5) Principal Factors of Performance and Economy," 27 December 1951, folder C-LVT/A1-1, 1952, box 167, entry 1017G1, RG 19; and memo, Rear Adm. R. M. Watt, Jr., Bureau of Ships, for Admiral Sylvester [assistant chief of the Bureau of Ships for ships], 13 December 1951, sub: New Design of LVT at Borg-Warner, Kalamazoo, Michigan, ibid.

253. McKinsey report, B–4; and Lewis report, 1-3.

254. Ltr, Assistant Chief of Staff, G–4, Headquarters, USMC, to Chief of Staff, Headquarters, USMC, 3 June 1953, sub: LVT Situation, folder X27, Vehicles, Tracked, Combat, 1 June 1953–31 July 1953, box 191, entry 102, RG 127.

255. Memo for file, LCdr. J. W. Schiffel, 12 February 1951, sub: LVT Turret Design and Development, folder LVT/S11, 1951, box 689, entry 1005, RG 19; and memo for file, H. M. Jacklin, Jr., Code 518, Bureau of Ships, 20 February 1951, sub: Dual Purpose 105-mm. Howitzer Turret; Development for Use in LVT (A), folder C-LVT/S72, 1951, box 144, entry 1017F, RG 19.

256. Ltr, Resident Supervisor of Shipbuilding, USN, Kalamazoo, Michigan, to Chief, Bureau of Ships, 23 November 1954, sub: LVT Program, Information for Quarterly Progress Status Report for the Bureau of Ships Progress Conference Scheduled for 13 December 1954, folder LVT/L4-3, vol. 5, from 9/29/54, box 2, entry 1008, RG 19.

257. Ltr, Chief, Bureau of Ships to Commander, Mare Island Naval Shipyard [et al.], 26 May

1953, sub: LVT Program, Quarterly Program Status Report of the Bureau of Ships Production Progress Conference of 8 June 1953, encl. to memo for file, Capt. L. V. Honsinger, Code 506, Bureau of Ships, 10 June 1953, sub: LVT Program; Production Progress Report as of 8 June 1953, folder C-LVT/L4-3, 1953, box 155, entry 1017H1, RG 19.

258. Ltr, Chief, Bureau of Ships to Supervisor of Shipbuilding, USN, and Naval Inspector of Ordnance, Chicago, Illinois [et al.], 21 June 1955, sub: LVT Program, Quarterly Program Status Report of the Bureau of Ships Production Progress Conference of 11 July 1955, folder LVT/L4, vol. 2, from 5/14/55, box 1, entry 1009, RG 19.

259. See JWS [LCdr. J. W. Schiffel] handwritten note, 13 June 1951, atch to memo for file, LCdr. J. W. Schiffel, 15 June 1951, sub: 105-mm. Howitzer Dual Purpose Turret for LVT(A)(6), Components for, folder LVT/S72, 1951, box 690, entry 1005, RG 19.

260. McKinsey report, B–9. In December 1953, the commandant of the Marine Corps recommended to the secretary of the Navy that the LVT Continuing Board be dissolved, saying in part: "It has become increasingly evident to me that the functioning of the LVT Continuing Board is unnecessary pyramiding of administrative processes." BuShips concurred with the commandant's recommendation and the secretary of the Navy dissolved the board in June 1954. See ltr, Gen. Lemuel C. Shepherd, Jr., Commandant of the Marine Corps, to Secretary of the Navy, 7 December 1953, sub: Development and Modernization of Landing Vehicles, Tracked; Administrative Procedure for, folder X27, Vehicles, Tracked, Combat, 1 Dec. 1953–31 Dec. 1953, box 191, entry 102, RG 127; ltr, Rear Adm. W. D. Leggett, Jr., Chief, Bureau of Ships (First Endorsement on CMC ltr AO-4F-am of 7 Dec 1953 to SecNav), to Secretary of the Navy, 18 December 1953, sub: Development and Modernization of Landing Vehicles, Tracked; Administrative Procedure for, folder LVT/L4-3, vol. 10, from 11/10/53, box 3, entry 1007, RG 19; and ltr, Commandant of the Marine Corps to Distribution List, 24 June 1954, sub: Secretary of the Navy's Continuing Board for the Development and Modernization of Landing Vehicles, Tracked, folder X27, Vehicles, Tracked, Combat, 1 Apr. 1954–30 June 1954, box 192, entry 102, RG 127.

261. Ltr, Assistant Chief of Staff, G–4, Headquarters, USMC, to Chief of Staff, Headquarters, USMC, 10 August 1953, LVT Production Program, folder X27, Vehicles, Tracked, Combat, 1 Aug. 1953–30 Nov. 1953, box 191, entry 103, RG 127.

262. Ltr, George Prifold, Manager, LVT Division, Ingersoll Products Division, Borg-Warner Corporation, to Chief, Bureau of Ships, 18 August 1953, sub: LVT Research and Improvements, folder LVT/L4-3, vol. 8, from 9/17/53, box 2, entry 1007, RG 19.

263. Lewis report, 4.

264. Retired Rear Adm. Edward A. Ruckner, who served in key positions in BuOrd in the 1950s, possessed a skeptical view of accelerated programs: "[W]hen you look back on it there really wasn't any great reason for [acceleration], because all those wars that were going to happen next year never happened. They said, 'You must have it two years from now or three years from now.' The wars didn't occur and many pretty good developments got sabotaged because they hadn't been debugged. And once you started to put them in the Fleet, the cost of retrofitting that you found was needed became horrendous." See Rear Adm. Edward A. Ruckner, USN (Ret.), interview by Dr. Peter Bruton, Booz, Allen & Hamilton, September 1974, 14, box 13, BAH Records, OAB, NHC.

265. G–4 Staff study, 6, A4-5.

I. Sources: Jeffrey G. Barlow, *Revolt of the Admirals: The Fight for Naval Aviation, 1945–1950*, 188-90; John T. Hayward, "The Atomic Bomb Goes to Sea," *The Hook 9*, no. 4 (Summer 1981): 22-27; and John T. Hayward and C. W. Borklund, *Bluejacket Admiral: The Navy Career of Chick Hayward*, 191-92.

CHAPTER VIII

Centralization Begins: OSD and Acquisition, 1953–1960

Events of the late summer and fall of 1957 intensified the fears of many Americans, already anxious about the nuclear world in which they lived. In August and then again in September, the Soviets announced successful tests of an intercontinental ballistic missile. Such news was disquieting, given the apparent failure of the first two test flights of the U.S. intercontinental ballistic missile, Atlas, at about the same time (June and September). On 4 October 1957, the Soviet Union placed the world's first artificial satellite, named Sputnik I, in orbit. The Soviets had previously announced that a satellite project would be part of their participation in the International Geophysical Year (IGY), the worldwide scientific effort to explore the earth, the sun, and outer space, which ran from 1 July 1957 through the end of 1958. With the appearance of Sputnik I, the unease that accompanied the Soviet ICBM tests approached hysteria in some quarters.[1] Dr. James R. Killian, Jr., who soon after was appointed special assistant to the president for science and technology, recalled that Sputnik I "created a crisis of confidence that swept the country like a windblown forest fire."[2] The image of U.S. technological superiority seemed shattered, replaced by the nightmare vision of hydrogen bombs falling on helpless American cities. Subsequent developments fueled the widespread sense of insecurity. In early November, Sputnik II, carrying the dog Laika, followed its beeping predecessor into space. A month later, the Navy's Vanguard rocket (also part of the IGY), bearing a grapefruit sized-satellite intended for earth orbit, exploded on the launch pad at Cape Canaveral in Florida. By the end of the year, portions of a top-secret study of U.S. defenses, prepared by a high-level scientific advisory group appointed by President Eisenhower, had begun to leak to the press.[3] Submitted to the president in November, the report emphasized the growing Soviet strategic nuclear capability, especially progress in long-range missiles, and described the United States as being "wide open" to attack.[4] In time, administration critics began to claim that the country was at the wrong end of a "missile gap."

In the midst of the alarmist atmosphere, President Eisenhower remained calm and deliberate.[5] On 9 January 1958, in his State of the Union address, the president, although conceding that the United States was "probably somewhat behind the Soviets in some areas of long-range ballistic missile development," nonetheless vigorously affirmed the deterrent power of the nation's strategic forces. But to ensure that the country would maintain the capacity to defend itself in the future, he recommended an extensive program of military, economic, and social measures. According to the president, the first need was to fashion a defense organization that could overcome disputes between the military departments over the development and employment of modern weapons, such as missiles that cut across traditional service boundaries, and that could integrate those weapons efficiently into the nation's defenses.[6]

In April 1958, Eisenhower presented Congress with a plan to reorganize the Department of Defense. One of its key features was to improve weapons acquisition by concentrating more power in the Office of the Secretary of Defense. Signed into law in July, the Department of Defense Reorganization Act of 1958 was the Eisenhower administration's second major restructuring of that department. The first, approved by Congress in mid-1953, also had aimed at greater efficiency in acquisition by strengthening the authority of the secretary of defense. But the 1953 reorganization did not succeed, its failure necessitating reform five years later.

After outlining the Eisenhower administration's defense policy and strategy, this chapter focuses on the evolution of OSD's organization for acquisition. It shows how the framework implemented in 1953, rather than strengthening the secretary of defense's control of weapons acquisition, in fact, diminished it. Following the analysis of organizational development, the chapter then examines OSD's role in the attempt to reduce the length of the weapons acquisition cycle. In 1955, concerned that the Soviet Union was acquiring new warplanes at a much faster rate than the United States, the secretary of defense formed a committee to examine ways to speed up military aircraft development, production, and deployment. It represented OSD's first major intrusion into the operation of the weapons acquisition process—an activity traditionally controlled by the military departments. The chapter's final section covers OSD's involvement in issues related to the people, both military and civilian, who designed, developed, and procured materiel for the armed forces. Although modest and largely ineffective, OSD's actions in this area marked the start of the long road toward the creation of a specialized and distinct "acquisition workforce."

THE EISENHOWER ADMINISTRATION AND NATIONAL DEFENSE

During the years of his presidency, Dwight Eisenhower's strongly held conviction that a balance should exist between military security and other aspects of American life influenced acquisition more than any other factor. It led directly to vigorous efforts to keep military spending in check, in part through a defense policy and strategy designed literally to "get the most bang for the buck" by emphasizing strategic nuclear forces. This orientation not only determined the types of weapon systems to be acquired but also generated increased rivalry between the services that, ironically, threatened the objective of achieving defense economies.

Eisenhower was the nation's most successful and well-known soldier and was committed to guaranteeing its safety, but he was no militarist. For him, military power was only one aspect of national strength. A sound economy, which made a well-armed force possible, was equally important. Excessive defense spending that led to deficits and to inflation would undermine the economy. A weakened economy, in turn, would require the imposition of controls limiting individual freedom. Such restrictions might result in a garrison state and ultimately the destruction of American democracy.[7]

To hold defense costs down but maintain security at the same time, the Eisenhower administration adopted the policy and strategy known as the "New Look."[8] Its central tenet was that the United States should rely primarily on the threat of "massive retaliation" with nuclear weapons delivered by strategic air forces to deter and, if necessary, defeat Soviet aggression. With national security assured by a powerful strategic deterrent, it would be possible to achieve significant savings through reductions in expensive, manpower-intensive conventional forces.[9] In contrast to the rapid-buildup, "year-of-maximum-danger" orientation that characterized the Truman administration's Defense Department budgets after the Korean War began, the New Look aimed at lower budget levels that could be sustained over the neither-peace-nor-war, "long-haul" character of the Cold War.[10]

Aided by the end of the Korean War, the Eisenhower administration initially managed to achieve substantial reductions in the military budget. The Truman rearmament budgets had peaked at $60 billion in FY 1952 and had dropped to just under $47 billion the next year.[11] For FY 1954 the Truman administration had proposed to spend nearly $41 billion. The Eisenhower administration slashed this figure by more than 12 percent to under $36 billion.[12] Throughout the remainder of Eisenhower's two terms, Department of Defense outlays climbed steadily, but not precipitously, despite fears of a "bomber gap" in the mid-1950s and a "missile gap" toward the end of the decade.[13] The largest military budget Eisenhower submitted to Congress was $41.8 billion for FY 1962.[14]

The Eisenhower Defense Department budgets financed a force structure that clearly reflected the New Look. All of the services lost people from FY 1954 through FY 1961: the number of active-duty military personnel declined from 3.3 million to just under 2.5 million. Ground forces took the biggest cuts, with the Army's active-duty military strength dropping from 1.4 million to 859,000 and the Marine Corps' from 224,000 to 177,000.[15] During these same years, the number of Army divisions shrank from 20 to 14, although Marine Corps divisions held steady at 3.[16]

While ground forces contracted under the New Look, air power, especially strategic air power, including both aircraft and missiles, expanded. Except for FY 1954, the last year that reflected spending for the Korean War, the Air Force drew the largest share of the Defense Department budget annually, averaging over 44 percent from FY 1955 through FY 1961.[17] In December 1953, the Strategic Air Command possessed 762 bombers, more than half piston-engine B–29s and B–50s, and combined piston-and-jet-engine B–36s. By the end of 1960, SAC's bomber force had more than doubled to 1,735 aircraft, all jet-propelled B–47s, B–52s, and B–58s.[18] The Navy was less enthusiastic about the New Look's emphasis on the nuclear air offensive than the Air Force, but its aircraft carriers, equipped with nuclear weapons–capable, heavy attack planes such as the AJ–1 Savage and the A3D Skywarrior, also formed part of the strategic deterrent in the 1950s.[19]

In the year and a half from mid-1959 through the end of 1960, the first land and sea-based strategic missiles, the products of many years of costly development, began to join aircraft as operational elements of the nuclear deterrent force. They included the Air Force's Snark, a subsonic, jet-powered "cruise" missile with intercontinental range (then considered to be 5,000 or more nautical miles); Atlas, the first operational ICBM; Thor, an intermediate range ballistic missile (IRBM), capable of hitting targets approximately 1,500 nautical miles distant; and the Navy's Polaris, an IRBM with a 1,200 nautical mile range that could be launched from a submarine operating below the surface.[20]

During the Eisenhower years, the combination of downward pressure on Defense Department budgets and emphasis on strategic offensive systems heightened interservice friction. The disputes may not have been as dramatic as those between World War II and the Korean War, but they were intense and persistent. The Army challenged what it viewed as an overreliance on strategic air power and a neglect of conventional forces. Nevertheless, despite its opposition to the New Look, the Army sought a place in the strategic arena. Its Jupiter missile competed directly with the Air Force's Thor for the land-based, intermediate range ballistic missile mission. In 1956, the secretary of defense's decision to assign operational control of Jupiter to the Air Force was a stinging defeat for the Army. The Navy, although not pleased with conventional force cuts, sought to expand its role in the nation's strategic deterrent with its Polaris IRBM. Fired from hard-to-detect nuclear-powered submarines, the missile threatened to reduce sharply the Air Force's near monopoly of the strategic air offensive.[21]

In the 1950s, interservice competition in the missile field included more than strategic offensive systems. Rivalry for air defense responsibilities was also keen. This resulted in the development of several land-based, surface-to-air missiles with comparable capabilities such as the Army's Nike Hercules and Talos (a missile originated by the Navy for use at sea, developed by the Army in a land-based role, and considered by the Air Force for air base defense), and the Air Force's Bomarc B.[22] A similar situation existed with surface-to-surface missiles with ranges of approximately 500 nautical miles—the Air Force's Matador and the Navy's Regulus, both cruise missiles, and later an improved version of the Army's Redstone, a ballistic missile.[23]

Early in 1957, in testimony before the House Appropriations Committee, Deputy Secretary of Defense Reuben B. Robertson, Jr., conceded that Matador and Regulus might have been combined. At the end of the year, Clifford Furnas, former assistant secretary of defense for research and development, explained that OSD had tried for three years to combine the two programs and that all involved thought it would be a good idea. The attempt failed, said Furnas, because the services insisted that "'It has to be my missile.' They were never able to resolve that. So now we have . . . both Regulus and Matador."[24]

Although devoted to the Army, where he had spent most of his life, Eisenhower, unlike many contemporary American military leaders, was not a partisan of his own service. A strong advocate of a unified defense establishment, he abhorred interservice rivalry's disruptive effects.[25] As president, he was also well aware that competing weapons programs would likely increase the budgets that he was trying to hold down. Nonetheless, in late 1955, in agreeing that both the ICBM and IRBM programs should be accorded the "highest priority," Eisenhower sanctioned a full-blown competition between the services to develop the latter.[26] Some historians have suggested that the president consented to this approach because he became convinced that parallel development efforts would be the best way to produce an operational, intermediate range missile in the shortest time.[27] But even if true, he had approved the IRBM competition only reluctantly.[28]

His approval of multiple IRBM programs notwithstanding, President Eisenhower remained fundamentally hostile to weapon system competition among the services. During a briefing on guided missiles at a meeting of the National Security Council in August 1956, he asked about interservice rivalry. Wilfred McNeil, the OSD comptroller, responded that Nike Hercules competed with Talos, and Matador competed with the Redstone system. Secretary of Defense Charles Wilson added that "he [Wilson] would get into trouble if he tried to drop one of the projects." The president was not impressed, commenting that "we might have to get into trouble; in any case, it would be no worse than the Suez problem."[29]

By the time of the Sputnik crisis in the fall of 1957, Eisenhower had lost patience with the fragmented weapons development process in the Department of Defense, suffused as it was with competition between the services. According to Killian, it was "one of the things that troubled Ike the most during his presidency."[30] And the president was not alone in this view; critics in Congress, many scientists, and administration insiders shared it. In December 1957, for example, Furnas, who had resigned as assistant secretary of defense for research and development at the beginning of the year but still served on the department's Defense Science Board, spoke candidly about the problem before an interservice audience at the Industrial College of the Armed Forces: "I recognize full well the autonomy which is assigned, essentially by law, to each of the services and their responsibility for developing the weapons as well as using them later. But I do think we have to admit . . . there is some very severe and wasteful, difficult, unbridled competition; and this unbridled competition is undesirable."[31] The next month, in the State of the Union address, the president made clear that the way to put a stop to interservice rivalry in weapons programs was to give more control over research and development to the secretary of defense.

ORGANIZATION FOR ACQUISITION

The Eisenhower administration implemented two reorganizations of the Department of Defense—the first in 1953 when it came into office, and the second in 1958 following the launch of the Sputniks. Both sought to strengthen the authority of the secretary of defense. With respect to acquisition, the first failed. Indeed, instead of bolstering the secretary of defense's oversight of materiel programs in the military departments, the 1953 reorganization fragmented the formation of acquisition policy, leaving OSD in a relatively less powerful position in relation to the services than before the restructuring. As a result, duplicative and expensive weapons programs proceeded with few restraints, especially in the missile field. In the latter half of 1957, Soviet missile and space triumphs contrasted sharply with American setbacks during the same period and seemed to signal deficiencies in U.S. weapons acquisition. To correct these perceived weaknesses, the administration implemented several organizational changes at the Department of Defense, culminating in the Reorganization Act of 1958, which established the position of director of defense research and engineering (DDR&E), with its unprecedented control over the services' research and development programs.[32]

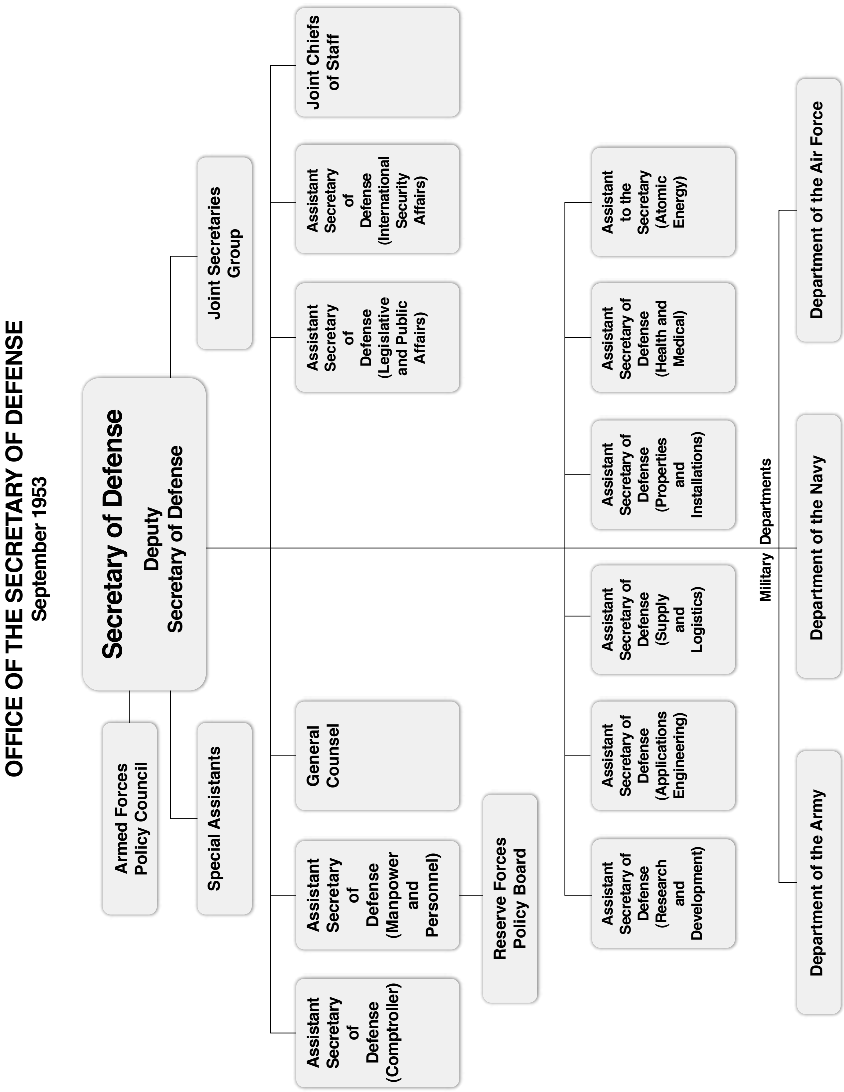
President Eisenhower presents the Medal of Freedom to outgoing Secretary of Defense Wilson, 9 October 1957.

The Reorganization of 1953

The flawed reorganization of 1953 was the product of the management philosophy of Charles Wilson, Eisenhower's first secretary of defense. The president of General Motors and an engineer by training, "Engine Charlie" Wilson had seemed the perfect choice to head the Defense Department. He had no background in military affairs and thus would be unlikely to challenge the president in the realm of military policy and strategy. On the other hand, many thought his proven managerial skills and extensive industrial experience, most notably in procurement and production, would be useful in fashioning a defense organization that would promote efficiency and economy.[33]

Soon after taking office, Wilson named a special committee chaired by Nelson Rockefeller, then head of the president's Advisory Committee on Government Organization, to study the department's operations. In a memorandum to Rockefeller, Wilson provided suggestions for the group to use in its deliberations. "My basic concept of the most effective way to organize the Defense Department," he wrote, "is in the form of a decentralized organization for administration (Army, Navy, Air), and a centralized organization (the Defense Department itself [i.e., Office of the Secretary of Defense]) for coordinated policy and control."[34] This organizational pattern resembled the structure at General Motors, with its semiautonomous subsidiaries such as Chevrolet, Buick, and Oldsmobile receiving policy direction from corporate headquarters.[35] In early April, the Rockefeller Committee presented its recommendations to Wilson, who endorsed and forwarded them to the White House. At the end of the month, President Eisenhower submitted the proposals, known as Reorganization Plan No. 6, to Congress, where they were quickly approved, becoming effective on 30 June 1953.[36]

Reorganization Plan No. 6 supplied a framework for implementing the management philosophy that Wilson favored. Under it, the secretary of defense would provide broad policy direction to and coordinate the activities of the military departments with the help of nine assistant secretaries of defense and other assistants to the secretary, such as the general counsel. Similar to corporate vice presidents at General Motors headquarters, they would supply information and recommendations to assist the chief executive, the secretary of defense, in making decisions and formulating policy.[37]



Source: Adapted from Chart 6 (Office of the Secretary of Defense, 22 September 1953), in Trask and Goldberg, *The Department of Defense, 1947–1997*, 22.

The plan's impact on acquisition management was especially far reaching. It abolished both the Research and Development Board and the Munitions Board, spreading their duties among four newly established assistant secretaries of defense: research and development, applications engineering, supply and logistics, and properties and installations.[38] The assistant secretary for research and development and the assistant secretary for applications engineering divided the responsibilities that previously belonged to the Research and Development Board. The assistant secretary for supply and logistics absorbed most of the Munitions Board's functions, although some were taken up by the assistant secretary for applications engineering and some by the assistant secretary for properties and installations. The four new assistant secretaries also shared supervision of acquisition with the assistant secretary of defense (comptroller), Wilfred McNeil, who continued the influential role he had played since the department's founding. The assistant secretaries were to confine themselves to policy formulation and coordination, and not become involved in "operations"—a frequent complaint the services had leveled against the Munitions Board.[39]

But rather than strengthening policy direction of acquisition, the reorganization fragmented and weakened it. In less than a year, conflict arose between the offices of the assistant secretary of defense for research and development and the assistant secretary of defense for applications engineering. The clash, described by one historian as "The Battle for Control of the R&D Process," stemmed from traditional sources of bureaucratic rivalry—missions that were sometimes at cross purposes, a failure to define functional boundaries clearly, and personal ambition.[40] As a result, OSD did not always present a unified front to the services, thereby undermining the secretary of defense's authority.

Wilson chose Donald A. Quarles to become the first assistant secretary of defense for research and development. An engineer rather than a scientist, Quarles had most recently been president of the Sandia Corporation, which built nuclear weapons. Herbert F. York, a physicist who would become the first director of defense research and engineering in 1958, described him as "intelligent, conservative, cautious, and unflappable."[41] Quarles' duties encompassed most of the functions that had been performed by the Research and Development Board. He was to advise the secretary of defense on research and development matters, develop policies and procedures that would produce an integrated defense research and development program, ensure that the services complied with OSD guidance, review the services' research and development budgets and programs, and work with the Joint Chiefs of Staff to effect a close relationship between research and development and strategy.[42]

Donald A. Quarles, assistant secretary of defense (research and development), 1953–1955; secretary of the Air Force, 1955–1957; deputy secretary of defense, 1957–1959.
Courtesy, U.S. Air Force.

Donald A. Quarles (1894–1959)

Deputy Secretary of Defense Donald Quarles died from a heart attack, suffered in his sleep at home on 8 May 1959. Following a funeral service at Washington National Cathedral on 12 May that was attended by the vice president and top civilian and military leaders of the armed forces, his body was transported in a procession to Arlington National Cemetery. President Eisenhower was present at the graveside service, which included honors appropriate for a deputy secretary of defense, former service secretary, and military veteran—a flyover at 1,500 feet by two 12-plane flights of Air Force and Navy jet fighters, a 19-gun salute, the traditional three rifle volleys, and taps.

Born in Van Buren, Arkansas, on 30 July 1894, Quarles graduated from Yale with a bachelor's degree in 1916, enlisted in the Army in 1917, and served with the Rainbow Division in France and Germany during World War I, attaining the rank of captain of field artillery. In 1919, he went to work in Western Electric Company's engineering department (which became Bell Telephone Laboratories in 1925). Although he studied theoretical physics part time at Columbia University in 1920–1921 while employed at Western Electric, Quarles was an engineer. In 1948, after nearly three decades with the company, most of those years in engineering management positions at Bell Labs, he became vice president of Bell. He then served concurrently in 1952–1953 as vice president of Western Electric and president of the Sandia Corporation, a Western Electric subsidiary that operated the Sandia Laboratory in New Mexico for the Atomic Energy Commission.

> On 1 September 1953, Quarles was sworn in as assistant secretary of defense for research and development. In August 1955, following a conflict of interest controversy that forced the resignation of Secretary of the Air Force Harold Talbott, Quarles took over that post. He became deputy secretary of defense in May 1957 when Reuben Robertson, Jr., returned to the private sector. Throughout his service in these three key Defense Department positions, Quarles proved to be an effective and loyal administrator. As assistant secretary of defense for research and development, he quietly sought to counter efforts by Frank Newbury to expand the responsibilities of the office of applications engineering at the expense of his own office. When he became secretary of the Air Force, Quarles supported the Eisenhower administration's efforts to hold down defense costs by limiting the service's R&D budget and by slowing down some ICBM program activities. His self-described "poor man's approach" put him at odds with much of the service's uniformed leadership and with Trevor Gardner, his top civilian assistant for research and development. Before he died suddenly in May 1959, Quarles was thought to be the leading candidate to succeed Secretary of Defense Neil McElroy, who had previously indicated that he intended to leave office by the fall. [1]

In addition to his own staff, Quarles called upon the military departments and the nation's scientific and technological community for assistance in carrying out his duties. A Research and Development Policy Council, made up of the top civilian and military research and development officials in each of the departments, provided Quarles with advice on major policy issues. Below the Policy Council, two different types of committees performed most of the work related to the office. More than a dozen coordinating committees, each chaired by a member of Quarles' staff and with representatives from each of the military departments, covered specific areas of research and development. A slightly smaller number of technical advisory panels, composed of expert consultants drawn from the private sector, were organized by fields roughly paralleling those of the coordinating committees. The job of the advisory panels was to provide independent, outside advice both to the coordinating committees and to Quarles.[43]

Some of the responsibilities that had belonged to the Research and Development Board were assigned to the assistant secretary of defense for applications engineering. The Rockefeller Committee report described this position as functioning "in the broad field which lies between research and development, on the one hand, and the quantity production of weapons on the other."[44] A Department of Defense directive, approved in December 1953, specified that the assistant secretary of defense for applications engineering was to develop policies and procedures for weapons, equipment, and systems to ensure that: (1) the minimum kinds would be acquired with "least cost, effort, and time";

(2) proper testing would determine their readiness for development, production, and use; (3) simplicity of design and operation, reliability, producibility, and ease of maintenance would be taken into account; (4) standard and already available materials, components, facilities, processes, methods, and practices would be used whenever possible; and (5) consideration would be given to their suitability for inclusion in existing systems.[45] In short, the assistant secretary of defense for applications engineering was to focus on the transition from development to quantity production and service use.[46]

Frank D. Newbury, a design engineer in his seventies who had risen to become vice president for manufacturing and a director of the Westinghouse Corporation, served as assistant secretary of defense for applications engineering from late 1953 until the post was abolished early in 1957.[47] He adopted an organizational scheme for his office that differed somewhat from the one chosen by Quarles. Although an Applications Engineering Policy Council functioned in much the same way as its counterpart in Quarles' office, Newbury, who believed the committee approach to be generally ineffective, organized only six coordinating committees and did not establish anything comparable to the office of research and development's technical advisory panels. In place of the latter, Newbury employed a few outside consultants to advise the coordinating committees.[48]

Frank D. Newbury, assistant secretary of defense (applications engineering), 1953–1957, and assistant secretary of defense (research and engineering), 1957, is presented the Meritorious Civilian Service Award by Secretary of Defense Wilson. General Counsel Robert Dechert looks on.

Frank D. Newbury (1880–1969)

As assistant secretary of defense for applications engineering from 1953 to 1957, Frank Newbury sought to reduce defense costs by ensuring that new systems were proven before they entered large-scale manufacture, thus avoiding, or at least limiting, expensive modifications that often resulted from early production decisions. Newbury's approach to acquisition, along with the lack of a precise boundary separating research and development from production and his desire to expand the responsibilities of his own office, caused conflicts with two successive assistant secretaries of defense for research and development as well as many scientists.

Frank Newbury was born in Brooklyn, New York, on 9 June 1880. After receiving a bachelor's degree in mechanical engineering from Cornell University in 1901, he went to work for the Westinghouse Corporation as an apprentice engineer. He spent the next 45 years with the company, eventually becoming vice president for manufacturing and a member of the board of directors before retiring in 1946. After retirement, Newbury published two books: *The American Economic System* (1950) and *Business Forecasting: Principles and Practice* (1952).

While at Westinghouse, Newbury specialized in managing the transformation of designs into products suitable for manufacture. He also became acquainted with Charles Wilson during the years (1909–1919) the future secretary of defense worked for Westinghouse, some say as a Newbury subordinate. This personal connection and the production-oriented philosophy of acquisition that he developed at Westinghouse likely explain Newbury's selection to be assistant secretary of defense for applications engineering.

In February 1957, Secretary Wilson combined applications engineering and research and development into one position, the assistant secretary of defense for research and engineering, and named Newbury its head. This action seemed to confirm the view of many scientists that R&D was subordinate to production under Wilson. It also set the scene for a confrontation between Newbury and scientists on the recently chartered Defense Science Board. At a special board meeting on 4 April 1957, Newbury questioned whether the new advisory body would add anything to the advice already being offered by the services' scientific advisory boards. Newbury's dismissive attitude toward the board angered the scientific community and resulted in his resignation two weeks later. [II]

The creation of a high-level office concerned with applications engineering reflected the Eisenhower administration's emphasis on efficiency and economy in defense, particularly its belief that savings might be obtained by reducing production costs.[49] According to Republican officials, the production goals of the Truman military buildup had exceeded U.S. industry's existing capacity, leaving billions of dollars in procurement funds still not obligated in 1953.[50] They also alleged that the rearmament had largely ignored production factors such as considering producibility in the design of new systems and, as a result, it was carried out inefficiently and at greater cost than necessary. In testimony before the House Committee on Government Operations in June 1953, Deputy Secretary of Defense Roger M. Kyes explained why considering production during design was important: "Often designs developed in research activities are not suited to the most efficient production methods, whereas reasonable modifications in specifications can save the essential functional advantage resulting from important research discoveries while at the same time adapting the unit to faster, cheaper and more efficient production."[51] As the assistant secretary of defense for applications engineering, Newbury had a special responsibility to make sure that production was taken into account very early in the acquisition process and that quantity manufacture did not begin prematurely.

During the Truman rearmament, as previous chapters have demonstrated, the services pushed many systems into quantity production before development was complete. Quite often these "crash" programs required expensive modifications that delayed deployment when defects came to light after production. The Marine Corps' new tracked landing vehicle, the LVTP–5, was a typical example (see chap. 7).[52] By 1953, the LVTP–5 was well behind original delivery schedules and had far exceeded projected costs. In April 1954, Newbury informed the deputy secretary of defense that more than 500 of the LVTP–5s would have to be modified before being released for service use. To Newbury the lesson was clear: "This experience is an example of the futility of 'crash' programs. These short-cut programs do not necessarily 'buy time with dollars' as is sometimes claimed. They may waste both time and dollars."[53] Two years later, the evidence regarding premature production of weapon systems appeared conclusive. During a news conference, Secretary of Defense Wilson commented that "it looks like we have wasted a good many hundreds of millions of dollars by rushing things into production too quick or into big quantities before all the bugs were out of the product . . . ."[54]

Spearheaded by Newbury's office, OSD sought to ensure that systems were proven before entering production. In late 1954, for example, the Navy requested approval to use FY 1955 funds for a small production order of its new minelaying, reconnaissance, and attack seaplane, the P6M–1 SeaMaster, following the successful first flight of the aircraft's experimental model scheduled for March 1955 (see chap. 10). Based on a recommendation from Newbury and OSD Comptroller McNeil, Wilson denied the Navy's request to obligate the funds. "With the first article to fly in March [1955]," he wrote the secretary of the Navy, "it is questionable whether sufficient flight time could be logged and evaluated to enable a production decision prior to July 1955 [the beginning of a new fiscal year]."[55] Within a few months, OSD issued a directive stating that, "wherever practicable," production should not begin until a system's development and evaluation had been completed.[56]

Applications engineering's attempt to secure savings through production efficiencies conflicted with the principal objectives of the Office of the Assistant Secretary for Research and Development. In contrast to applications engineering, it sought to acquire systems equipped with the latest technologies that could offset the superiority in numbers presumably enjoyed by the nation's most likely opponents and to deploy those weapons as rapidly as possible. Achieving these goals favored the adoption of acquisition strategies, such as concurrency, that compressed acquisition time by overlapping development and production. In contrast, applications engineering's approach to acquisition was more deliberate; involved fewer, potentially expensive risks; and, to the dismay of advanced technology partisans, threatened to sacrifice system performance on the altar of economy.

But even had their main purposes not diverged, conflict between applications engineering and research and development would probably still have occurred. Both had parts to play during system development, but it was not clear at what point the responsibilities of one ended and those of the other began. Newbury's charter acknowledged the absence of a clear-cut boundary between the two, stating that applications engineering functions would normally be performed during "design for production [prototype construction], *but some can start in the early development stage*, or they can come in the production phase."[57] The ambiguity in roles stemmed in part from the inherent indivisibility of the weapons development cycle. In a 1955 assessment of OSD's management of research and development, the Hoover Commission's Subcommittee on Research Activities in the Department of Defense emphasized the "seamless web" nature of the acquisition process: "From an early stage in the research, development, design, and production cycle of weapons, Research and Development and Applications Engineering functions are present and inseparable. Research and Development and Applications Engineering for weapons are not successive, two-stage operations, but must go along together."[58] Despite the difficulties involved, OSD made several attempts to resolve the jurisdictional issue by clarifying the responsibilities of the two offices. None succeeded.

THE HOOVER COMMISSIONS

Established by Congress, formally titled the Commission on Organization of the Executive Branch of the Government, and chaired by former President Herbert C. Hoover (thus their popular name), the commissions of 1947–1949 and 1953–1955 had a common purpose: to study and investigate the organization and operation of the executive branch and to recommend changes to promote economy and efficiency. Both operated through functional task forces that prepared individual reports, with each commission submitting a final report to Congress in 1949 and 1955, respectively.

Although surveying the entire executive branch, the two commissions paid much of their attention to the Department of Defense. In matters affecting acquisition, the Hoover Commission of 1949 sought to increase the authority of the secretary of defense with respect to the budget and the procurement and management of supplies and other materiel. It also urged that better relations be established at the working level between the Joint Chiefs of Staff and the Research and Development Board and the Munitions Board.

The Hoover Commission of 1955 focused especially heavily on the military establishment (9 of its 19 reports dealt with the Defense Department) and on acquisition-related issues. It recommended that each military department establish an assistant secretary position to administer research and development and that a new agency (perhaps coequal with the military departments) be created to manage common supply and service activities for all the armed forces. Congress failed to approve the first recommendation. Not until 1961, when the Army created such a position, would all three services have an assistant secretary for research and development. Secretary of Defense Wilson rejected the commission's proposal for a super supply and service organization, maintaining that the single-manager plan already in operation, by which one department provided a commodity or service for all, would better achieve the objective of efficient business management.

Wilson responded favorably to other key commission recommendations. He approved the merger of the assistant secretary of defense for research and development and the assistant secretary of defense for applications engineering into one position, the assistant secretary of defense for research and engineering; established a high-level departmental scientific advisory body, the Defense Science Board; and issued department-wide policies designed to place more civilians in top DoD positions, especially in logistics fields, and to make careers in government service more attractive in other ways.

In 1958, DoD claimed to have implemented all but 49 of the 359 commission recommendations related to the department. But, in some cases, as this chapter demonstrates with respect to the commission's suggestions for improving the acquisition workforce, the services were dilatory in carrying out, or entirely ignored, some that became Defense Department policy. [III]

Along with competing missions and overlapping responsibilities, a third factor exacerbated the conflict—Frank Newbury's aggressive attempt to expand applications engineering's operating sphere at the expense of research and development's. The 1953 directives that specified the functions of the two offices were based on a compromise: the assistant secretary of defense for research and development would review service projects through "design development" (prototype construction and testing) that involved "new art"; the assistant secretary of defense for applications engineering would have that responsibility only for "old art" projects.[59] By mid-1954, Newbury had become dissatisfied with this arrangement. In early June, he informed Deputy Secretary of Defense Robert B. Anderson, who succeeded Roger Kyes the previous month, that the two offices were supervising many of the same development programs and that this led to "confusion in the military departments as well as in our offices." Furthermore, he complained that "'new art' has been interpreted so broadly by the Office of Research and Development that very little territory has been left for Applications Engineering in this area of supervising development programs."[60] Newbury proposed that his office assume responsibility for all design development programs and that the review authority of the Office of the Assistant Secretary of Defense for Research and Development should be restricted to research programs only. He defined research programs as those that "should be continued only far enough to develop basic information or to prove feasibility by means of relatively inexpensive models."[61] In other words, applications engineering would take over project review once the breadboard model or mock-up was completed and continue supervision through prototype construction and testing for service use.

In terms of funding, the division of responsibility urged by Newbury would mean a dramatic reduction in the scope of the review authority of the assistant secretary of defense for research and development. The Department of Defense's research and development appropriation for FY 1955 was $1.35 billion. By Newbury's calculation, only approximately $350 million, or just over 25 percent of the total, fit his definition of a research project. Thus, if he were to have his way, applications engineering would assume responsibility for the balance of $1 billion, roughly 75 percent of the R&D appropriation. In addition, Newbury wanted oversight of the funding for those R&D projects that the services financed with money from their procurement accounts. For FY 1955, Newbury estimated these funds would constitute $1 billion to $1.5 billion of the total of $14.5 billion appropriated for procurement.[62] Newbury tried to make the bitter pill of the reduction in his counterpart's review authority more palatable by pointing out that supervision of Defense Department research programs was still "the biggest administrative research job in the nation."[63]

Quarles stood his ground against Newbury's offensive. He pointed out to the deputy secretary of defense that practice in all of the military departments was for "development people" to exercise responsibility for a system through testing of prototypes; only after that stage was completed would the system be turned over to be engineered for production and use. "To stop earlier, at the research model stage, for example," he argued, "would leave so many questions unanswered that the exploratory work would either be abandoned, as having proved nothing useful, or it would be turned over for completion to essentially the same kind of talents in another organization, thus duplicating the talents and know-how required to do the job."[64]

To help resolve the dispute, Deputy Secretary of Defense Anderson engaged Mervin J. Kelly, president of Bell Telephone Laboratories, a physicist, and one of the nation's leading R&D administrators. With Kelly's assistance, Newbury and Quarles agreed on a plan, finalized in October 1954, to clarify responsibilities between the two offices so as "to present one OSD front to the Military Departments." The agreement did not alter the basic division of responsibility established by the 1953 directives. In this respect it constituted a rejection of Newbury's attempt to gain control of the lion's share of OSD's oversight of the services' research and development programs. Instead, the plan focused on mechanisms for forging a unified OSD position. The most important of these was to create four joint research and development and applications engineering coordinating committees. Quarles' office would chair and manage the committees for piloted aircraft and guided missiles; Newbury's office would run the committees for electronics and ordnance. Prior to this time, each office had its own coordinating committee in these fields. In addition to the joint coordinating committees, the compromise abolished the Applications Engineering Policy Council in exchange for Newbury being given a seat on the Research and Development Policy Council.[65]

The agreement brokered by Kelly did not dampen Newbury's desire to expand the applications engineering domain. In June 1955, supported by McNeil, he scored a major victory by convincing Wilson to assign applications engineering responsibility for reviewing the services' research and development projects financed from procurement accounts.[66] As noted previously, such funds could exceed the total of the R&D appropriation. Moreover, during the first half of 1955 Newbury would also attempt, although unsuccessfully, to gain control of all aspects of missile acquisition supervised by OSD.

In August 1955, Quarles left OSD to become secretary of the Air Force.[67] His successor, Clifford Furnas, chancellor of the University of Buffalo, did not come on board until December.[68] In a speech delivered just before taking up his new post, Furnas, who held a doctorate in chemical engineering, had alleged that engineers tended to impede the introduction of the most advanced technologies.[69] Such an attitude did not bode well for bringing an end to the bureaucratic tug of war between research and development and applications engineering.

Clifford C. Furnas, assistant secretary of defense (research and development), 1955–1957.

Clifford C. Furnas (1900-1969)

Clifford Furnas, who succeeded Donald Quarles as assistant secretary of defense for research and development in December 1955, came to the Defense Department with a clear conception of the research/development/production relationship. He believed that a production organization should not supervise R&D. Moreover, development engineers should continue with a new technology through production. Such views brought him into sharp conflict with Frank Newbury, assistant secretary of defense for applications engineering, who wanted to restrict the office of research and development to oversight of the military departments' research activities.

Born in Sheridan, Indiana, on 24 October 1900, Furnas attended Purdue University, participating in the 5,000 meters in the 1920 Olympic Games in Antwerp, Belgium, before graduating with a bachelor's degree in chemical engineering in 1922. After earning a doctorate in the same field from the University of Michigan in 1926, he worked for the U.S. Bureau of Mines as a physical chemist for five years, and then taught chemical engineering at Yale University from 1931 to 1941. While at Yale, he published several books exploring science and technology's impact on future society, including *America's Tomorrow* (1932), *The Next Hundred Years* (1936), and (with his wife, Sparkle) *Man, Bread and Destiny* (1937). During World War II he was employed first as a technical aide to the National Defense Research Committee and, beginning in 1943, as director of the Curtiss-Wright Corporation's research laboratory in Buffalo, New York. In 1946, the company donated the facility to Cornell University where it became the Cornell Aeronautical Laboratory with Furnas as its director.

While head of the Cornell laboratory from 1946 to 1954, Furnas, like many other leading scientists and engineers after World War II, lent his expertise to the Department of Defense, serving for two years as chairman of the Research and Development Board's Guided Missiles Committee. During this period, he also edited an important publication of the Industrial Research Institute, *Research in Industry: Its Organization and*

Management (1948) that contained chapters by research directors of major U.S. corporations, as well as one by Furnas entitled "The Philosophy and Objectives of Research in Industry." In September 1954, he was named chancellor of the University of Buffalo, taking a leave of absence from that position 15 months later to become the assistant secretary of defense for research and development.

After returning to the chancellor's post at the University of Buffalo early in 1957, Furnas oversaw the institution's merger with New York's state university system, becoming the first president of the State University of New York at Buffalo in 1962 and remaining in that position until his retirement in 1966. He also maintained close ties with the military establishment as a member of the Army Scientific Advisory Panel, the Naval Research Advisory Committee, and the Defense Science Board (chairman, 1961 to 1965) until his death in Amsterdam, the Netherlands, in 1969. [IV]

Soon after arriving at the Pentagon, Furnas added injury to his earlier insult of engineers by countering a recommendation made by Newbury's office. The preceding July, applications engineering had supported a request from the Marine Corps to obligate procurement funds to support development of a ground-launched version of the Sparrow air-to-air missile. Subsequently, the interdepartmental Joint Coordinating Committee on Guided Missiles received a briefing on the system. In mid-December, having been on the job less than two weeks, Furnas forced a halt in the missile's development until he was advised that the Army's ground-based anti-aircraft missile, Hawk I, could not meet the Marine Corps' requirement. According to the 1954 agreement, such a decision should have been taken through the joint coordinating committee, not by either of the two offices' acting alone. After learning what Furnas had done, applications engineering demanded that the two offices work together with the Marine Corps and Army to resolve the issue.[70] Although it may have been the result of unfamiliarity with established procedures rather than any aggressive intention, Furnas' action, combined with the implications of his speech, signaled a likely resumption of conflict between research and development and applications engineering. And whatever the incident may have foretold in that arena, it surely called into question the effectiveness of the joint coordinating committees.

While Quarles headed research and development, the contest with Newbury was relatively restrained and did not attract much attention outside the Defense Department. After Furnas arrived, it turned into open warfare and broke into public view. The escalation's casus belli was Wilson's decision in February 1956 to extend Newbury's review authority to encompass development projects that were proceeding beyond the exploratory or breadboard model stage to prototype construction and service use. This had been Newbury's objective all along. The move would effectively castrate the Office of the Assistant Secretary of Defense for Research and Development, limiting it to supervision of projects totaling approximately $350 million, a small fraction of the total research and development effort. Wilson, however, did not notify Furnas of the decision in advance.[71]

Backed by influential scientists and other advanced technology proponents, Furnas fought back, threatening to resign if the decision were not reversed. His cause was also aided by press attention that portrayed the conflict as being between "the scientists" and "the production men." Within a month Wilson, at Newbury's suggestion, withdrew the memorandum that had altered the division of labor.[72]

Newbury and Furnas continued to contest control of research and development for the rest of the year. Apparently emboldened by Wilson's (and Newbury's) retreat, Furnas initiated a counteroffensive at the end of March 1956, proposing that his office assume responsibility for all development projects, whatever their funding source, up to approval for service use.[73] In May, in a memorandum to the secretaries of the military departments and the principal combatants in OSD, Wilson attempted to halt the feud. He reaffirmed the status quo as it existed prior to February's attempt to redraw the boundaries: research and development and applications engineering would share responsibility for review of service programs funded by the research and development appropriation, as provided for by the October 1954 agreement, and applications engineering would have sole responsibility for programs funded by procurement and production funds.[74]

In October 1956, Newbury informed Wilson that the shared responsibility arrangement was unworkable and that he wished to leave his post immediately. But Wilson did not accept Newbury's request to resign. The latter's departure proved unnecessary in any case because Furnas resigned at the end of the year to return to the University of Buffalo, about a month sooner than he had originally planned when he first accepted the assistant secretary post. In February 1957, Wilson ended the dual oversight of research and development by combining the two positions into one, an assistant secretary of defense for research and engineering, and named Newbury its first incumbent. Newbury's triumph, however, was short-lived. In April, he too resigned, having been forced from office by pressure from scientists and others whom he had thoroughly antagonized.[75]

Centralization of Missile Program Oversight

The combination of the two warring positions—applications engineering and research and development—should have strengthened the secretary of defense's ability to integrate research and development in the Defense Department.

But the prospect of doing so was diminished by another organizational evolution: OSD gradually erected a centralized framework for supervising missile programs that was separate from the established organizational structure. By the time the Office of the Assistant Secretary of Defense for Research and Engineering was established early in 1957, this process, described by Furnas as a "vertical organizational splinter," was well under way.

The idea of breaking off missiles from the established channels for monitoring weapons acquisition in OSD first surfaced during the course of a review of the entire missile program that the secretary of defense had requested in the fall of 1954.[76] To conduct the assessment, Wilson appointed a committee under Newbury's general coordination (although he was not designated its chairman) that also included McNeil, Quarles, and Admiral Arthur W. Radford, the chairman of the Joint Chiefs of Staff. The services assigned liaison officers to keep abreast of the committee's activities and provide information as required.[77] During the course of the study, Newbury proposed that a new staff agency be established to supervise all aspects of missile acquisition except research. To be known as the Guided Missile Advisory Group, it would report directly to the secretary of defense, be headed by Newbury, and include as its members the same officials on the committee then reviewing the missile program. As was the case with the review committee, liaison officers would represent the military departments.[78]

In pressing for the Guided Missile Advisory Group, Newbury argued that such a body was necessary to overcome the weaknesses of the coordinating committees, especially their tendency to be dominated by the services.[79] One of the members of McNeil's staff described how the services had controlled the coordinating committee on guided missiles managed by Quarles' office:

> In fact, it has been reported that on occasion when a particular sensitive issue appears on the agenda, the three service members hold an informal preliminary meeting to establish a unanimous position prior to the convening of the Guided Missiles Coordinating Committee. Faced with unanimity amongst the service members, the OASD (R&D) [Office of the Assistant Secretary of Defense, Research and Development] representative feels pressured to go along in order to preserve the 'one big family' ideal.[80]

Newbury thought the kind of committee that he was advocating could check the services' power.

In April 1955, after several months of debate, Wilson's special review committee met with him and his deputy, Robert Anderson, to discuss the missile advisory group proposed by Newbury. At the meeting McNeil, who also favored direct staff action over operation by committees, supported Newbury. Radford and Quarles, however, opposed the plan. Radford thought that the secretaries of the military departments would protest vigorously. The JCS chairman also feared that it would not be long before there would be pressure to give other types of systems similar treatment. Quarles, who had been fighting the proposal for months, echoed Radford's point about special arrangements for other classes of weapons. He asked Wilson if the latter realized that the advisory group setup would transfer 90 percent of his (Quarles') office's missile work to Newbury's, effectively scuttling the agreement on a division of labor between research and development and applications engineering reached less than a year before. Wilson deferred making a decision at the meeting but indicated that he favored Newbury's advisory group concept because he too believed the coordinating committee approach had not secured sufficient control of missile programs.[81] At the end of August, Wilson, despite his stated preference, decided not to go forward with the missile advisory group, electing instead to give the Joint Coordinating Committee on Guided Missiles, in operation only since February, more time to prove itself.[82]

The grace period did not last long. In February 1955, in a report for President Eisenhower, the Technological Capabilities Panel of the Office of Defense Mobilization's Science Advisory Committee had urged that the ICBM program being run by the Air Force should be assigned the highest national priority and that an IRBM, either land or sea-launched, also be developed. By the fall of 1955, the two recommendations had been approved and the president had also given the IRBM equal priority to the ICBM.[83] Wilson, rather than relying on the established structure that included the Joint Coordinating Committee on Guided Missiles, sought to speed up the review and approval process for the ICBM and IRBM programs. In November, following the recommendation of a special Air Force committee, he formed the OSD Ballistic Missiles Committee that was chaired by the deputy secretary of defense and also included the assistant secretaries for research and development, applications engineering, supply and logistics, the comptroller, and a representative from the Bureau of the Budget. Its principal function was to review and approve development plans, including funding, for the ICBM and IRBM programs.[84] In March 1956, Wilson appointed a special assistant for guided missiles who reported directly to him and who also took over chairmanship of the OSD Ballistic Missiles Committee. According to the directive establishing the position, the special assistant's advisory and coordinating responsibilities extended to the entire missile field. But in practice, he concentrated on ballistic missiles.[85] About a year later, Wilson enhanced the authority of both the OSD Ballistic Missiles Committee and the special assistant for guided missiles. Along with the ICBM and IRBM programs, the OSD Ballistic Missiles Committee also began to monitor the earth satellite project (Vanguard), and the special assistant for guided missiles assumed formal responsibility within OSD for coordinating additional missile programs.[86] The Joint Coordinating Committee on Guided Missiles continued to function under the assistant secretary of defense for research and development (after February 1957, the assistant secretary for research and engineering) throughout these organizational changes. But shorn of cognizance over the most important missile programs, the committee's influence declined.[87]

Over the summer and early fall of 1957, U.S. missile failures combined with Soviet successes, particularly the launching of the two Sputniks on 4 October and 3 November, resulted in further centralization of missile management in OSD. On 9 October, in a change that had been announced in August, Neil H. McElroy, the president of Procter and Gamble, replaced Wilson as secretary of defense. Pressured almost immediately by Eisenhower to strengthen control over missiles, McElroy upgraded the position of special assistant for guided missiles to director of guided missiles and assigned the post substantially increased authority.[88] The new director of guided missiles was empowered to "direct" missile "research, development, engineering, production, and procurement" whereas the special assistant had been authorized only to "assist in the direction and coordination" of those activities. McElroy, reasoning that operational missiles were subject to further development, also added them to the responsibilities of the director of guided missiles (the special assistant's authority had ended once a missile had been adopted for service use). To support his activities, the director of guided missiles acquired the personnel on the staff of the assistant secretary of defense for research and engineering who had worked on missile policy, further weakening that office. But despite the apparently unambiguous charge to "direct," the power of the director of guided missiles was limited. He was not to be an operating executive and in that regard could not initiate or cancel contracts; that authority was reserved to the military departments.[89]

The Advanced Research Projects Agency

Among the purposes for centralizing missile management was to accelerate development and deployment of the most important systems by streamlining the review and approval process. Pursuing this objective by isolating missile oversight from that provided other weapon systems, however, came at a price—it undermined the assistant secretary of defense for research and engineering's responsibility to create an integrated research and development program in the Department of Defense. Speaking to the Industrial College of the Armed Forces in December 1957, former assistant secretary Furnas made this point metaphorically: "Inevitably, when you set up these vertical, specialized groups, you pull vitality and substance from your parent source of your research and development organization. . . . In other words, the splinters tend to be parasites. At times parasites may be very important, but you can only put on a few parasites and expect the parent to live. And the parent is the thing which must live for the long pull."[90]

More vertical splintering occurred when McElroy, in another response to the Sputniks, established the Advanced Research Projects Agency (ARPA) in early February 1958. Its first director was Roy Johnson, a vice president of General

Electric since 1948. Like the director of guided missiles, Johnson would report directly to the secretary of defense and would also be responsible for a distinct category of weapons—in this case, technologically advanced systems that did not yet clearly belong to one service or another, such as military satellites, other types of space vehicles, and antiballistic missiles. (In several instances, competing service programs were already under way in these areas.) But unlike any other element of OSD's organizational structure for acquisition, the Advanced Research Projects Agency could initiate and fund research projects on its own, contracting for them either directly or through the services. When a system being developed under an agency contract neared operational capability, it would be turned over to one of the services for further development, production, and deployment. The Advanced Research Projects Agency was also authorized to have its own laboratories, although it did not immediately acquire any.[91]

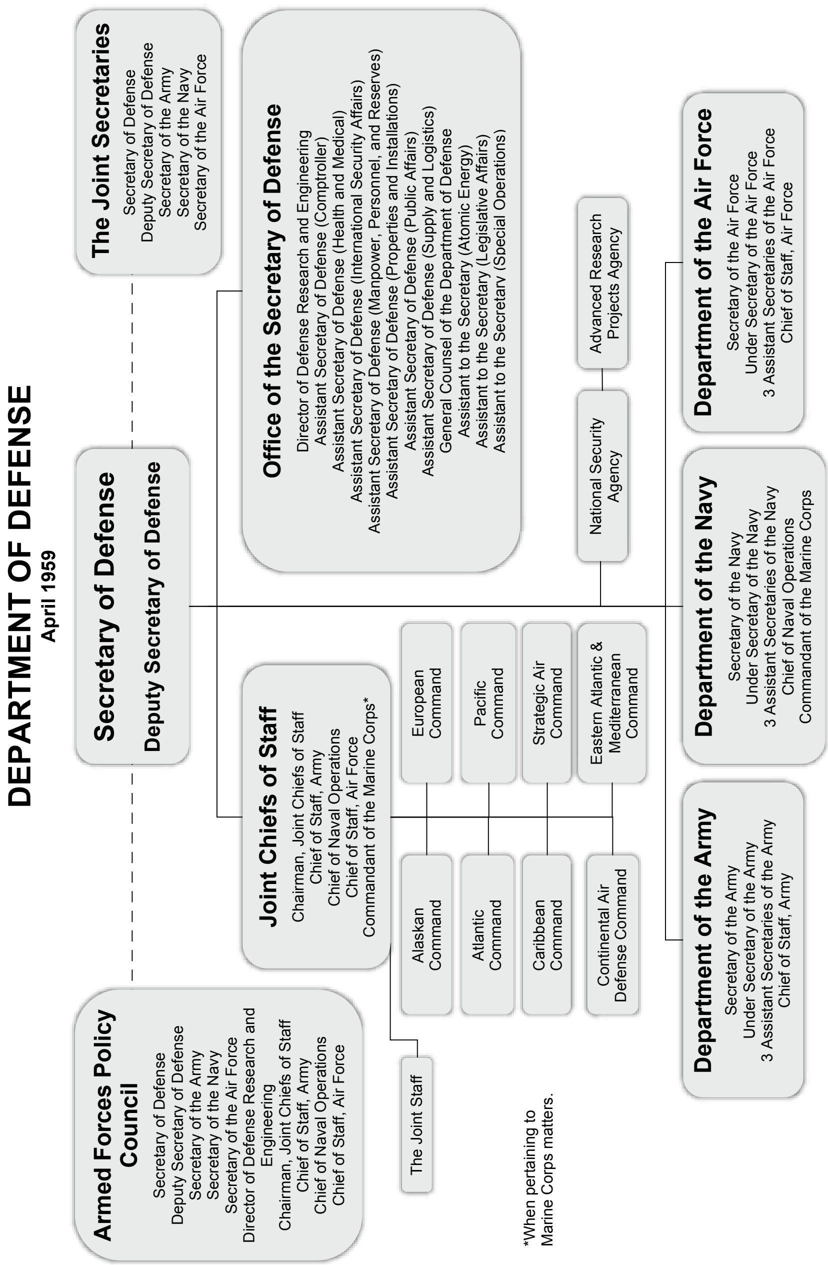
Secretary of Defense McElroy (left) with Roy W. Johnson, director of the newly established Advanced Research Projects Agency, February 1958.

When ARPA's charter was being drawn up, the services and the Joint Chiefs of Staff, unable to block the new agency's establishment because of the president's support, sought to prevent or at least limit its intrusion into the operating arena. They had long held that OSD's role was policymaking and coordination, not operations. The Air Force, then seeking preeminence among the services in space, mounted particularly strong opposition. In addition to the no-operating responsibilities argument, the Air Force also protested that ARPA would undermine the essential unity of the weapons acquisition process by separating initial research and development from the ultimate user of the system. By this time, the weapon system approach which involved concurrent development of a weapon's component elements including ground facilities and equipment and specialized training for the system's operators, had been institutionalized in Air Force regulations for several years. But service opposition was to no avail. ARPA would be an operating agency, planning and conducting its own research and development projects.[92]

The Reorganization of 1958

The position of director of guided missiles and the Advanced Research Projects Agency added appreciably to the secretary of defense's control of acquisition. Still, they did not go far enough in that direction to fulfill the promise, made by the president in his State of the Union address in January 1958, to effect a reorganization of the Defense Department that would end interservice disputes over weapons and integrate new systems into the nation's arsenal efficiently. The Department of Defense Reorganization Act of 1958, based on a plan the administration had submitted to Congress in April, sought to achieve these objectives. One of the legislation's key provisions established the position of director of defense research and engineering with unprecedented authority "to supervise all research and engineering activities in the Department of Defense" and "to direct and control" any of those the secretary of defense believed needed to be centrally managed.[93] The director of defense research and engineering's charter, issued by the secretary of defense early in 1959, specified the office's powers and responsibilities in greater detail. Among them were planning an integrated research and development program for the department; proposing an appropriate funding level to support it; recommending the assignment to a service of responsibility for developing a particular system; undertaking research projects directly by contract or through one of the military departments; and approving, modifying, or disapproving any Department of Defense research and development program or project.[94]

The legislation and charter accorded the new position status commensurate with the scope of its duties. The director of defense research and engineering would rank just below the deputy secretary of defense and the secretaries of the military departments, but above any of the assistant secretaries of defense, the director of guided missiles, and the director of the Advanced Research Projects Agency. The DDR&E would also sit on the Armed Forces Policy Council and be added to the Joint Secretaries group.[95]



Source: Adapted from Chart 7 (Department of Defense, April 1959), in Trask and Goldberg, *The Department of Defense, 1947–1997*, 29.

Herbert F. York (right), director of defense research and engineering, at a press conference, April 1960.

In December 1958, Herbert York, then only 38 years old, was appointed the first director of defense research and engineering. A physicist, York had headed the Atomic Energy Commission's Livermore Laboratory and had been chief scientist at the Advanced Research Projects Agency since early 1958. His appointment was especially significant because it seemed to symbolize the triumph of "scientists" over "production men," and a corresponding shift in priorities from achieving cost reduction through production efficiencies, which had motivated Wilson and Newbury, to maximizing the performance of new weapon systems, which had concerned Furnas and others. It was also consequential because York, who had served with Killian on the Office of Defense Mobilization's Science Advisory Committee, maintained close ties with the president's special assistant for science and technology and, after mid-1959, his successor, George B. Kistiakowsky. According to York, these personal relationships "probably played an important positive role in consolidating the authority and influence of all three men and their respective offices."[96]

The creation of the position of director of defense research and engineering provided an opportunity to rationalize OSD's management structure for research and development, at that time fragmented horizontally through the assistant secretary of defense for research and engineering and vertically through the director of guided missiles and the Advanced Research Projects Agency. The DDR&E's charter abolished the post of assistant secretary of defense for research and engineering. Within a short period, Secretary of Defense McElroy also eliminated some of the vertical splintering. The Advanced Research Projects Agency continued to report directly to the secretary of defense, but the director of defense research and engineering received the authority to supervise and coordinate the agency's projects as part of his supervision of the Defense Department's total research and development program. McElroy also downgraded the director of guided missiles to the status of special assistant, with duties limited to advising the secretary on the transition of missiles from development to deployment and chairing the OSD Ballistic Missiles Committee.[97]

The horizontal rationalization of OSD's management structure for research and development cleared a path for the director of defense research and engineering to forge an integrated research and development program for the department. By the end of the Eisenhower administration, however, not much progress had been made. In fact, the Research and Development Board had attempted more centralized research and development planning than the DDR&E. Just as its predecessors, the Office of the Director of Defense Research and Engineering acted more as a judge of competing service programs than as the shaper of a larger whole.[98]

The Department of Defense Reorganization Act of 1958, with its provision for a director of defense research and engineering who possessed nearly complete control of military research and development, was a continuation of the trend toward greater concentration of power in the Office of the Secretary of Defense that had begun with the first amendments to the National Security Act in 1949. When the Eisenhower administration came into office in 1953, it intended to strengthen the secretary of defense's authority over the services' materiel activities, but the reorganization of OSD implemented that year produced the opposite effect. A fuzzy division of responsibilities and internal infighting between the offices of the assistant secretaries of defense for research and development and applications engineering fragmented and weakened policy formation. Under the pressure of external events and the president's prodding, Wilson and then McElroy sought to increase OSD's control over the acquisition of certain high-priority systems by creating organizational mechanisms separate from those providing oversight to other weapons programs. This vertical splintering, although facilitating the acquisition of some systems, made unifying the services' research and development programs more difficult.

THE ROBERTSON COMMITTEE

Few problems in acquisition have received more attention than the increasing length of the weapons procurement cycle, usually defined as spanning the period from the determination of a requirement for a system through research and development, production, and deployment. In 1991, the report of an acquisition streamlining task force sponsored by the Defense Science Board found that with respect to development time alone (production might add several more years), programs beginning in the 1940s and 1950s required six years, while those beginning in the 1970s and 1980s needed eight.[99] The Defense Science Board analysis was but one of numerous studies by presidential commissions, Defense Department boards and committees, and other groups and individuals to address the issue of cycle stretchout in the half century following World War II.[100] Although largely unnoticed by historians or acquisition professionals, the Ad Hoc Study Group for Manned Aircraft Weapon Systems, appointed by Secretary of Defense Wilson in the fall of 1955 and usually referred to as the Robertson committee after its chairman, Deputy Secretary of Defense Reuben Robertson, was the first formal Defense Department-wide examination of the issue.[101] The committee was less significant for any shortening of the cycle that may have resulted from its recommendations than was its impact in two other areas. First, its report focused attention on project management, particularly the crucial role played by the project officer, or program manager.[102] Second, the committee's investigation was the harbinger of a not-too-distant future that would see OSD begin to insert itself directly into the acquisition process, an activity the services believed only they should control and conduct.

DEFENSE SCIENCE BOARD

Reflecting the concerns of some scientists that interservice rivalry was preventing exploitation of weapons technologies that would best serve the nation rather than simply the interests of a particular military service, the Second Hoover Commission (1955) recommended a Department of Defense–wide standing committee "to canvass periodically the needs and opportunities presented by new scientific knowledge for radically new weapons systems." In response, Assistant Secretary of Defense for Research and Development Clifford Furnas, with Secretary of Defense Wilson's approval, established the Defense Science Board to operate under his (Furnas') office.

The new board held its first meeting on 20 September 1956. Appointed by Furnas, its 25 civilian members included the chairmen of the service scientific advisory committees; the chairmen of the technical advisory panels in Furnas' office; the chairmen or directors of the National Academy of Sciences, National Bureau of Standards, National Advisory Committee for Aeronautics, and the National Science Foundation; and seven members at large. At the end of October 1957, following the first Sputnik, the new secretary of defense, Neil McElroy, upgraded the board, increasing its membership to 28, and requiring that it report to him through Paul D. Foote, the assistant secretary of defense for research and engineering who had replaced Frank Newbury in that post.

Once organized, the Defense Science Board quickly asserted itself. In the spring of 1957, the board successfully resisted Assistant Secretary of Defense for Research and Engineering Frank Newbury's attempt to push it aside (see Newbury profile in this chapter); later in the year, it urged the department to put greater emphasis on basic research; and, in 1958, it strongly supported Secretary of Defense McElroy's plan (that became part of the Defense Reorganization Act of 1958) for greater centralization of military R&D management in the Office of the Secretary of Defense. Ironically, Herbert York, the first director of defense research and engineering under the new law, made little use of the board and the pace of its activity slowed. Over the next several decades, the board's influence rose and fell depending on the degree to which particular secretaries of defense relied on its advice and how well it operated in the politically complex defense environment.[V]

Origins and Operation of the Robertson Committee

The Robertson committee was born in the skies over and near Moscow. On May Day 1954 and in rehearsals for the annual flyby a year later, the Soviets showed off several new aircraft. They included a swept-wing, long-range jet bomber, with the NATO code name Bison, that was similar to the Strategic Air Command's B–52; a four-engine, turboprop bomber, designated Bear, that U.S. intelligence believed might be configured as a tanker to refuel the Bison bombers; and an all-weather fighter that could intercept the relatively slow-moving B–36, which, for that reason, was limited to nighttime attacks. The appearance of the bombers was a surprise. As recently as January 1954, JCS chairman Admiral Radford told a congressional committee that the Soviets would not have a long-range jet bomber, even in the prototype stage, until 1958. Also troubling was that the Bison, first seen in May 1954, appeared in combat formations of several aircraft only a year later, suggesting a very rapid progression from prototype to quantity production. In a memorandum for Secretary Wilson, Admiral Radford explained that the Bison's evolution demonstrated the Soviet Union's "exceptional ability to accomplish the task of executing a large aircraft project from design through production to probable operational status in a short period of time." In contrast, B–52 development had been much slower. The B–52's initial set of performance characteristics was identified in late 1945, but the aircraft's first flight did not take place until 1952. Serial production was only just beginning in 1955.[103]

Reuben B. Robertson, Jr., deputy secretary of defense, 1955-1957, being sworn in by White House Administrative Officer Frank K. Sanderson as President Eisenhower looks on.

To many observers, especially to the administration's critics in the Senate, Soviet aircraft advances seemed evidence of U.S. inferiority in the air and justification for increases in defense spending that they had been urging. In late May 1955, perhaps more in response to such pressure rather than to the actual state of U.S. air power vis-à-vis that of the Soviet Union, the president approved Wilson's request to accelerate B–52 production, and in July the Air Force speeded up several other aircraft programs.[104] At the end of September, following a discussion in the Armed Forces Policy Council, Wilson also established a special committee to study how the services acquired manned aircraft systems and to make recommendations that might "shorten the time presently required to take a weapon from concept to inventory."[105]

The special committee, formally named the Ad Hoc Study Group on Manned Aircraft Weapon Systems, was a major Department of Defense effort.[106] In addition to its chairman, Robertson, and its vice chairman, Frank Newbury, other OSD members were the comptroller and the assistant secretaries for research and development and for supply and logistics. The under secretaries of the Army, Navy, and Air Force represented the military departments. A staff, composed of special consultants and representatives from OSD and the services, supported the Robertson committee's activities and drafted the report. During the course of its investigation, the staff interviewed 230 officials from the Department of Defense and 125 employees of 18 aircraft manufacturing and research organizations.[107]

In a preliminary report to the Robertson committee principals, the committee's staff underscored the significance of the task that had been assigned. It cited an Air Force intelligence estimate, coordinated with the Central Intelligence Agency, that compared U.S. and Soviet aircraft acquisition cycle times. According to the analysis, the period from concept through production of a complex air weapon system averaged 8 years for the United States but only 5½ years for the Soviet Union.[108]

The Robertson Committee Report

In July 1956, after more than six months' work, the Robertson committee submitted a classified, 84-page report to the secretary of defense that recommended numerous "Action Objectives" to be implemented by the services and OSD to reduce the cycle time for manned aircraft. Most fell into three broad areas: requirements determination, project management, and Department of Defense-contractor relations. In the committee's view, one-to-two years could be cut from the weapons cycle by putting its recommendations into effect.

The Robertson committee first considered how the services developed requirements for new aircraft systems and concluded that the data gathered and analyses prepared to justify them were inadequate. Furthermore, the services failed to enlist the support of civilian policymakers early enough in the requirements process. Indeed, asserted the committee, the "combination of insufficient facts at the outset, and insufficient review by policy officials must be counted as the primary causes for instances in which aircraft weapon systems programs are suspended or drastically changed in mid-stream."[109]

To correct these deficiencies the committee made several recommendations. One was that the services should devote more staff time to generating new requirements. When the committee conducted its investigation, Air Force and Navy officers assigned to requirements billets spent up to 50 percent of their time responding to requests for modification or modernization of aircraft already in service, but only 10 to 20 percent working on new requirements.[110] Another recommendation was to improve the quality of information relating to a new system's technical feasibility, military effectiveness, schedule attainability, and total cost. To achieve this objective the committee suggested that the Air Force and Navy provide requirements development staffs with pertinent research studies, enlist the assistance of expert advisers from both within and outside the services, and, as requirements were being considered, conduct experiments to establish the potential uses of the new systems.[111] A third committee proposal—one unlikely to be popular with the uniformed military—was to include civilian policymakers at the outset of the requirements determination process. In both the Navy and Air Force, operational requirements were approved at or below the level of the military chief of staff without participation by representatives from the civilian secretariats. Civilian officials usually became involved only at the point, often too late in the committee's opinion, when substantial funds had to be committed to the program. According to the Robertson committee, the early and continuous review of planned requirements for new weapon systems by high-level civilian officials in the military departments would "assure that adequate information is developed upon which to base sound decisions and assign realistic priorities." Ultimately, the secretary of defense would have to assign priorities for major programs that involved the interpretation of national objectives, the resolution of conflicts in roles and missions, and decisions on long-range financial requirements and the extensive use of national resources.[112]

Following the approval of an operational requirement, 5 to 10 years were required to design, test, and produce a new system. The Robertson committee thought that a year or more might be saved through "more vigorous project management." To strengthen project direction, it specified ways to increase the status, qualifications, and authority of project officers, and to elevate project management's position within service organizational structures. Normally lieutenant colonels and commanders managed weapons acquisition programs. The committee recommended that the services put higher-ranking officers in charge; in the case of selected high-priority projects, these should be brigadier generals or, in the Navy, senior captains. To improve project officer qualifications and performance, it suggested that specialized training programs be established, that tours be lengthened from an average of 26 to 32 months to an average of 5 years, and that incoming and outgoing project officers overlap each other by 6 months. To expand the project officer's authority, it proposed that he be given control over all aspects of system development. Project officers controlled airframes, but they usually lacked cognizance over funding, facilities, major engineering change proposals, and subsystems such as engines.[113]

The Robertson committee recognized that the ability of project officers to execute weapon systems programs effectively and expeditiously also depended heavily on how the services organized to manage those programs. In both the Air Force and Navy, project officers (including the heads of Air Force weapon system project offices) were located at relatively low organizational levels in the developing commands, most often in the branch of a division. Also, they shared responsibility for system management with officers of similar rank in their own organizations, at service headquarters, and in field agencies.[114] In addition to elevating project officers to higher organizational levels, the committee recommended that project management be afforded a degree of autonomy from functionally aligned parent organizations. According to the committee, vertical approaches to acquisition management such as those employed by the Soviet Union for aircraft and by the United States for long-range ballistic missiles were successful because they gave project managers direct access to the highest decision-making levels and thus the assurance of adequate resources and cooperation from lower echelons.[115] Although not calling directly for the Air Force and Navy to reorganize along these lines, the report presented charts that depicted vertical organizational patterns each might consider.[116]

Along with requirements determination and project management, the Robertson committee singled out government-contractor relations as a third major area presenting opportunities to shorten the procurement cycle. In the judgment of the committee, the services unnecessarily complicated those relationships with "meticulous supervision" exercised through restrictive procedures that badly needed simplifying. In addition to slowing aircraft acquisition, the "tediousness" of this supervision "destroys the producer's ability and initiative to create advanced and more effective systems."[117]

The Robertson committee identified several actions the services could take to loosen some of the restraints imposed on industry and thereby gain time. One was to use more so-called "weapon system contracts" that allowed prime contractors greater freedom in selecting subsystems and in choosing and supervising subcontractors.[118] Another was to replace detailed specifications that mandated exactly how the aircraft was to be developed and produced with general performance standards. In support of this recommendation, the report cited one company's estimate that 31,000 of the 40,000 engineers employed throughout the aircraft industry were involved in interpreting, analyzing, or complying with military specifications. Although conceding that delays caused by requiring detailed specifications could not be measured precisely, it noted that one company, using its own funds and specifications, built an aircraft prototype in 10½ months, as compared with the 3 to 5 years usually required to construct one according to military specifications.[119]

Expediting the approval of engineering change proposals was yet another way to buy time. The Air Force, according to the committee, had an especially poor record in processing them. The Air Materiel Command reviewed approximately 1,200 engineering change proposals every month; each took an average of 4 months to be approved. Only a small number were submitted to Air Force headquarters, but obtaining Air Staff approval for them sometimes required 9 to 12 months. Noting that about 95 percent of all engineering change proposals were ultimately approved, the committee recommended that competent engineers be assigned to the staffs of Air Force plant representatives and be empowered to authorize changes that did not involve aircraft configuration, safety, specifications, or weight.[120]

Other timesavers cited by the committee included expanding the authority of the developing commands to approve preliminary contracts; providing partial funding while detailed contract specifications and work statements were being submitted, coordinated, and processed; and approving contractor requests for government-furnished industrial facilities and equipment, potentially slashing from 250 to 150 the number of days normally required to obtain this authorization.[121]

The Robertson committee was also convinced that improving government-industry communications would speed up system acquisition. Contractor reporting should be reviewed to ensure that report volume and content was essential for program evaluation. By the same token, contractors should be apprised of information essential to job performance, such as changes in program objectives. The Defense Department should also increase contractor access to scientific and technical intelligence.[122]

In its analysis of government-contractor relations, the Robertson committee underscored the project manager's potential to influence the length of the procurement cycle, especially with respect to flight testing. Flight tests gradually expanded an aircraft's performance envelope. In the past, the services had tended to skimp on the allocation of test aircraft, including static test articles. But static tests were especially important. Inadequate data from them slowed flight testing, thereby increasing the likelihood that major deficiencies would not be uncovered until the test program was well along. If, to save time, quantity production began before sufficient testing was completed, then expensive and time-consuming modifications often resulted. To manage this process more efficiently, the committee recommended that the project officer coordinate both the manufacture of test aircraft to ensure that an adequate number were allocated, and the proper timing and rate of quantity production in relation to test results.[123]

In all, the Robertson committee report contained 21 major "Action Objectives" to be carried out by the services and OSD. In the letter transmitting its report to the secretary of defense, the committee asked that it stay in existence until the end of 1956 to monitor progress toward achieving the objectives. But the committee opposed enforced compliance; the services and OSD should be allowed to "proceed with implementation in the manner best suited to the individual departments." This was much too permissive an approach for Frank Newbury, the assistant secretary of defense for applications engineering and the committee's vice chairman. Although he signed the letter forwarding the report, Newbury appended his formal objection, stating that he did not believe "the recommended implementation goes far enough."[124]

Implementation of the Robertson Committee Report

The Armed Forces Policy Council received a one-hour briefing on the Robertson committee report and discussed its contents in mid-August 1956. Secretary of the Air Force Quarles was sharply critical. He challenged the relevance of the principal allegation that had brought the committee into being, namely that the Soviets had acquired the Bison bomber in half the time that it took the B–52 to enter the U.S. inventory. Quarles thought this was not necessarily a legitimate comparison. In his view the pertinent questions were: Was the B–52 a state-of-the-art system? And was it available for service use when needed? Quarles also expressed several other criticisms of the report's recommendations: resources were inadequate to carry them out; elevating project officers to higher organizational levels was not realistic; it might not be wise to allow too much freedom to contractors; and OSD's apparent intention to get involved in operations was troubling. Quarles' objections undoubtedly placed Under Secretary of the Air Force James H. Douglas, Jr., a member of the Robertson committee, in an uncomfortable position. After reinforcing his boss' opposition to OSD's intrusion into operations, Douglas added what may have been the bottom line as far as the services were concerned. None of the report's action objectives, he asserted, "represented directives to the Air Force but rather have been presented in such a way that these actions could be implemented where practical." In response, Deputy Secretary of Defense Robertson, chairing the meeting in Wilson's absence, denied that OSD planned to become involved in service operations. He also appeared to quiet fears that the report's recommendations were mandatory, saying diplomatically that "it was the hope of the committee to maintain some follow-up action in order to answer the question: How far can these actions be implemented?"[125]

With the administration under fire in Congress for allegedly allowing a "bomber gap" to develop, in part because the aircraft procurement cycle took so long, action on the Robertson committee report would provide some ammunition to answer the critics.[126] At the end of August 1956, OSD issued a press release summarizing the report's principal findings and indicating that the committee would monitor progress on their implementation through the end of the year.[127] Early in February 1957, Robertson submitted a summary of the measures adopted by the services and OSD to Secretary of Defense Wilson. In a letter accompanying the follow-up report, the deputy secretary of defense pointed out that not only had the services responded positively to many of the committee's suggestions, but they had also come up with their own initiatives. Additionally, they had begun to apply recommendations for shortening the time cycle to other major systems such as missiles, communications, and some weapons unique to ground forces.[128] The follow-up report, although unclassified, was not released to the public; instead OSD announced that Wilson had received the document and outlined some of the time-saving actions that had been put into effect.[129]

Robertson promised Wilson that the services would continue to provide follow-on reports.[130] But high-level OSD interest waned rapidly. The Ad Hoc Study Group had gone out of existence, and Robertson, its chairman, left office in April 1957 to be replaced as deputy secretary of defense by Quarles, no fan of the committee's report. The issue seemed dead.

The events of the fall of 1957 revived concern about the length of the weapons cycle. On the heels of the Sputnik launchings, Congress opened investigations into U.S. space and missile programs. The inquiry conducted by the Preparedness Investigating Subcommittee of the Senate Armed Services Committee, chaired by Lyndon Johnson, was especially aggressive. In January 1958, following hearings in November, the subcommittee made seventeen recommendations related to the nation's defense posture. Number nine on the list was to "reduce lead time in the development of weapon systems by cutting down on decision time and by simplifying procurement procedures."[131]

Neil McElroy, Wilson's successor, and Quarles were both scheduled to appear before the subcommittee in April 1958 to report on Defense Department action on the subcommittee recommendations. To prepare for the hearings, Quarles checked into the implementation of the Robertson committee's action objectives. In February, after reviewing the Navy's follow-on reports (the last report had been submitted in August 1957), Quarles informed Secretary of the Navy Charles S. Thomas of his conclusion that "implementation has been spotty." The deputy secretary of defense asked Thomas for an update on steps the Navy had taken to shorten the aircraft acquisition cycle and to suggest ways that OSD might be helpful in that regard.[132]

The Navy's reply, prepared in the Bureau of Aeronautics, contrasted dramatically with the glowing report that Quarles' predecessor sent to Secretary of Defense Wilson a year earlier. Some of the Robertson committee's action objectives had been met, but not others. According to the Navy report, money was part of the problem: inadequate funds limited its ability to purchase additional test vehicles and to expand the use of advance payments to contractors. Similarly, manpower ceilings and reductions prevented hiring personnel of the caliber required to administer the complex contracting process. Also, although the Navy had developed new procedures for speeding up responses to contractor industrial facility requests, "with the exception of high priority projects, the total processing time remains about the same."[133]

Taking advantage of Quarles' offer to suggest how OSD might assist efforts to cut cycle length, the Navy's report pointed the finger at bureaucratic restraints imposed from above as a principal cause of delays. These included repeated examinations of aircraft procurement programs during the budget process, the "tedious and time consuming steps" imposed by the Armed Services Procurement Regulation, the requirement to document and justify every action involving expenditure of government funds, and the need to provide program information to a host of agencies both within and outside the Department of Defense. So long as the time of those involved in acquisition was consumed in satisfying such demands, asserted the report, "the delays which occur in the procurement process will be difficult to avoid."[134]

The Navy's report revealed the limits of the Robertson committee's reach. The committee's action objectives were not mandatory and, other than requiring periodic reports, OSD had not followed up to encourage execution. The services were thus free to implement the recommendations they liked and to ignore those they did not.

In no case was the impact of service independence more obvious than the response to the Robertson committee's urging that civilian policymakers participate at an early stage of the requirements process. In the committee's view, the involvement of high-level civilians in the military departments and in OSD would help ensure that information on new requirements was sufficient for making program decisions and for assigning priorities. The Navy, however, simply refused to cooperate, providing the assistant secretary of the Navy for air with copies of new requirements only at the time they were issued. The Air Force was more responsive, providing drafts of new requirements to its assistant secretary for research and development for review and comment.[135]

Even complete access to the uniformed military's requirements inner sanctum, however, would not have done the civilians much good. Compared to the huge military staffs, those of the assistant secretaries were small. Furthermore, they lacked analytical tools to assist in evaluating programs, particularly methods and instruments to compare types of systems such as aircraft against missiles or one kind of missile against another. In the 1960s, with the advent of "cost effectiveness" studies performed by OSD's Office of Systems Analysis, civilian officials believed they possessed the means to compete with "military experience." And when Robert McNamara became secretary of defense in 1961, the Department of Defense would be led by a civilian with the will to do so.[136]

Whatever the shortcomings in its implementation, the Robertson committee report, in highlighting the roles of the project officer and the project office in managing weapons acquisition, may have stimulated the expansion and strengthening of these management methods. In January 1958, following the study's completion, the Air Force instituted a reorganization that elevated weapon system managers two echelons above their previous positions.[137] During the course of the Robertson committee's inquiry, the Navy's Bureau of Aeronautics introduced "program managers" into its organizational structure. Assigned to the office of the bureau's assistant chief for plans and programs, the program manager coordinated the different phases of a system's acquisition that were being monitored by various project officers at lower levels in the bureau. The bureau also began to experiment with the project office concept, physically locating the program manager and others involved in the acquisition of the all-weather, twin-jet Grumman A2F–1 (later redesignated the A–6A Intruder) in the same office (see chap. 10).[138] The Army had employed program managers/project officers only for a handful of key systems, including the Redstone and Jupiter missiles. In early 1957, the Army reported that the chiefs of its technical services were considering expanding their use.[139]

Along with drawing attention to the importance of effective project management, the Robertson committee's recommendations regarding the weapons cycle foreshadowed OSD's direct entry into the acquisition process in the next decade. In the 1960s, OSD would seek to create a coherent Defense Department planning program and budget out of the separate service programs through institution of the Five Year Defense Program (FYDP) and the Planning, Programming, and Budgeting System (PPBS). These measures sought to underpin allocation of resources through application of systems analysis techniques, and to dictate the criteria for determining when individual systems could proceed from one development phase to another.

THE ACQUISITION WORKFORCE

In the 1950s, along with addressing questions related to acquisition organization and process, OSD also began to concern itself with the acquisition workforce—the military and civilian employees in the Department of Defense responsible for developing and procuring new weapon systems. Typically, influences from outside the department precipitated OSD's involvement. And, just as typically, although it established policies to remedy many of the problems that were identified, OSD did not enforce implementation by the services.

DEFINING THE ACQUISITION WORKFORCE

The terms "acquisition" and "acquisition workforce" were not used in the 1950s. Indeed, there was no concept of a coherent acquisition workforce, however defined. Nevertheless, the functions associated with acquisition remained relatively constant in the half century following World War II. Thus, with a couple of exceptions, the identification of acquisition workforce positions contained in the Defense Acquisition Workforce Improvement Act of 1990 may reasonably be applied to the 1950s. These include positions in program management; systems planning, research, development, engineering, and testing; procurement, including contracting; industrial property management; logistics; quality control and assurance; manufacturing and production; business, cost estimating, financial management, and auditing; education, training, and career development; construction; and joint development and production with other government agencies and foreign countries. (The creation of "career development programs" for government employees was in its infancy in the 1950s; personnel specialists who worked on designing such programs would not have been considered part of the acquisition workforce of that day.)

Since the idea of a discrete acquisition workforce did not exist in the 1950s, determining its size is difficult. In *The Weapons Acquisition Process* (1962), Merton Peck and Frederic Scherer attempted to calculate the number of military officers and civilian government employees holding "fairly responsible positions in the weapons acquisition process" in 1958. According to their estimate, of the approximately 300,000 uniformed officers on active duty in 1958 (out of a total military force of 2.6 million), 5,500 were assigned to research and development and 5,500 to procurement. Of the 43,000 civilian scientists and engineers employed by the Defense Department the same year (out of a total civilian workforce of 1.28 million), nearly half were in research and development. At the same time, about 10,000 civilians served as contract negotiators, price analysts, contract administrators and auditors, and contract attorneys. Of course the entire DoD acquisition workforce was much larger. Although complete and comprehensive figures are not available for the 1950s, the following statistics give an indication of its size. In 1954, 39,000 military personnel and 63,000 civilians of all ranks and grades participated in research and development activities alone. In 1959, the newly formed Bureau of Naval Weapons (a merger of the Bureau of Aeronautics and Bureau of Ordnance) numbered 204,500 personnel. [VI]

Throughout the 1950s, a variety of sources pointed to inadequacies in the acquisition workforce. During the Korean War, Secretary of Defense Robert Lovett asked retired Rear Adm. Lewis Strauss, who had surveyed interservice materiel coordination during World War II, to investigate reasons for production delays that were slowing the military buildup. Strauss named quantitative and qualitative weaknesses in "manpower assigned to procurement" as factors responsible for lagging production.[140] In 1954, a subcommittee of the House Committee on Government Operations, chaired by R. Walter Riehlman (R-N.Y.), reported numerous difficulties regarding civilian scientific and technical personnel employed in the Department of Defense, particularly their relationships with the uniformed military.[141] In 1955, several committees, task forces, and subcommittees of the president's Commission on the Organization of the Executive Branch of Government (the second Hoover commission) noted personnel deficiencies in both research and development and in procurement, especially in contracting activities.[142] Among analyses of the acquisition workforce made during the 1950s, the recommendations of the Hoover Commission would have the most impact on the Defense Department, prompting OSD to issue several workforce-related directives. In 1956, as discussed in the preceding section, the Robertson committee had focused on shortcomings in the status, knowledge, and experience of officers managing aircraft acquisition programs.[143] Finally, in late 1957 and in 1958 following the Sputnik alarms, Congress held hearings on acquisition workforce recruitment and training.[144]

Military Officers

Since military officers occupied the vast majority of command and other management positions in acquisition, examinations of the workforce paid special attention to this group. Officers in the acquisition workforce reflected the major division in the officer corps between specialists who performed "support" functions and officers in the combat arms (primarily the infantry, artillery, and armor in the Army; the fleet and its air component in the Navy; and the Air Force's flying units) that carried out the services' "operational" missions. Officers in the support category served in the technical services in the Army (e.g., Chemical Corps, Ordnance Corps, Signal Corps); in the Supply Corps and as "engineering duty officers" in the Navy; and in "occupational fields" such as armament, research and development, production procurement, maintenance engineering, and supply in the Air Force.[145] Most officers in acquisition billets were support specialists, but a substantial number, especially those holding key command and staff slots, came from the combat arms.

During the 1950s, three interrelated issues with respect to officers appeared repeatedly in assessments of the acquisition workforce. First, not enough were qualified in acquisition management to satisfy the growing demand. Second, the services' personnel assignment policies often worked against development of an experienced and technically competent officer acquisition cadre. Finally, many officers did not find careers in acquisition appealing. The services attempted to commission officers with appropriate educational backgrounds and to provide training for those assigned to acquisition billets, but the number with suitable qualifications, especially in science and engineering, fell short of requirements throughout the decade. In 1958, for example, the Navy was 900 officers short of the 3,000 with graduate degrees in science and engineering that it needed.[146]

The services' personnel assignment policies contributed to the problem created by shortages. During their careers, combat arms officers often spent one or two tours in support assignments. Known as "career broadening," the major objectives of this practice were to create "generalists" conversant with the complexity of modern warfare and to bring a "user" or "operational" perspective to support activities.[147] In addition to career broadening, the Air Force also assigned "rated" officers (pilots and navigators) who were excess to current needs to positions in support specialties normally held by "nonrated" officers (those not qualified to fly) in order to maintain an adequate supply of flying officers to meet wartime or other emergencies.[148] Along with assigning operations types to acquisition, the services also rotated officers, whether support or combat arms specialists, through acquisition positions very rapidly. In the 1950s, tours in acquisition averaged three years, with two years or less not unusual, especially for officers from the combat arms. Moreover, there was usually no overlap between incumbent and replacement. Frequent assignment rotation was common to all the services during this period and not peculiar to acquisition. Among the policy's purposes were to adjust to fluctuations in personnel ceilings and military programs, to enable officers to assume increasing levels of responsibility, to provide opportunities for professional schooling, and to ensure that overseas billets were filled.[149]

Nearly every study of the acquisition workforce in the 1950s underscored the negative effects of the services' military personnel policies. Shortages and career broadening resulted in the assignment of inexperienced and inadequately qualified officers to technically complex programs costing hundreds of millions of dollars. For example, in 1956, as part of a survey of Department of Defense contract administration, the staff of the House Appropriations Committee reported: "It appeared almost universal that officers with very little industrial background, and in several airframe plants unqualified officers, were assigned positions of authority."[150] Frequent rotation disrupted continuity in program management, prevented officers from acquiring sufficient technical competence, and made it difficult to determine accountability for systems with development cycles lasting as long as 10 years.[151] According to the Riehlman subcommittee, rapid officer rotation was "disturbing and harmful to the research and development program."[152] "The job suffers," echoed the Hoover Commission's research and development subcommittee.[153] The consequences were also apparent in contracting. In 1956, the Appropriations Committee staff report on procurement practices offered a blunt assessment: "The high rate of turnover of procurement and contract administration personnel, both military and civilian, has seriously affected the efficiency of [those] functions. . . . The Government's position in negotiation, controlling production costs and maintaining contract deliveries is seriously weakened by lack of personnel continuity . . . ."[154]

A third obstacle to achieving a stable, competent officer acquisition workforce of adequate size was that many officers did not find the career field attractive. For one thing, acquisition assignments were far removed from the services' primary missions and lacked prestige.[155] For another, acquisition specialists found that the top assignments in their field went to officers from the combat arms and that they had little chance of reaching flag rank. In the Army in 1955, for example, infantry, artillery, and armored officers filled about 75 percent of 180 key jobs in logistics.[156] As a result of its inquiry, the Riehlman subcommittee concluded that "discriminatory promotion policies" tended to "steer capable officers interested in scientific work away from such assignments."[157]

Professional Civilian Workforce

Although military officers monopolized the leadership posts, civilian specialists made up most of the professional acquisition workforce. But recruiting and retaining qualified civilians, particularly in science, engineering, and other technical fields, proved difficult. In 1956, 9 out of 10 science and engineering graduates who were offered jobs in the Department of Defense declined. Moreover, the ratio of losses of top scientists and engineers that same year was four times greater than in 1951.[158] Numerous factors accounted for the recruitment and retention problem.

Inadequate pay headed the list.[159] In the 1950s, the demand for scientists and engineers in defense work, whether employed in government or in the private sector, was high, absorbing about half the nation's supply of scientists alone.[160] The Department of Defense, however, was hard pressed to obtain qualified personnel in these and other fields because private-sector pay was 15 to 20 percent higher than compensation that could be offered civil servants. Private-sector retirement plans and other fringe benefits were also beginning to match or exceed those formerly making government service attractive.[161] Furthermore, the number of top-rank, highest-paying civilian jobs, including the so-called "super grade" positions, was limited by law.[162] According to the Hoover Commission, civil service pay and grade limitations made it "impossible to build a civilian staff of the quality necessary for effective and efficient operation of the highly specialized programs of research and development."[163]

Many of the difficulties in retaining a first-rate civilian acquisition workforce stemmed from differences in military and civilian culture and, except at the very highest levels, the preferential status enjoyed by the uniformed officer corps throughout the Defense Department. The potential for cultural clash was at its height in research and development facilities that were commanded by military officers and staffed largely by civilian scientists. Testifying before the Riehlman subcommittee, William Webster, former chairman of the Research and Development Board, explained that tensions were likely to arise because "the ideal military man is trained to give commands and expect obedience." Such characteristics, said Webster, were opposite those desired in a laboratory head "who is trained to use very talented individuals to the best advantage, to let them have their heads wherever possible, to put them to work on things they want to work on and probably do best, to supplement their weaknesses and use their strengths."[164] Wallace R. Brode, who headed the Science Department at the Naval Ordnance Test Station at Inyokern (China Lake), California, from 1945 to 1947, recalled the behavior of a new commander who fit the model of the authoritarian military leader described by Webster:

> The new Commanding Officer on his first day had an inspection and lined up all his shall we say limited number of troops, whatever you call them out there, seamen, on the parade grounds for a formal transfer of Command. And he got all the scientists out too and lined them up in a row. And he made a speech to the scientists. It was a short speech, and it was to the effect that commanding a research laboratory was no different from commanding a battleship. He proceeded then to issue a group of orders. Like a battleship we were in the middle of an isolated area in the desert and we had to have our proper supply. He was going to have none of this trucking off to Pasadena every day to get a new piece of film or a radio tube or something that burned out. We were to determine what we needed for six months and order it, and there wasn't going to be any of this quick ordering of materials. We had to figure what we needed for six months in advance and order it just as a battleship has to be stocked and ready to go to sea for six months at a time.

"And it is that sort of philosophy," asserted Brode, "which grinds the scientists to a halt very quickly."[165]

To be fair, there were many officers in the services who adapted easily to organizations populated largely by civilians and operated effectively in them. For example, when Capt. F. L. Ashworth took over as commander of the Naval Ordnance Test Station in the mid-1950s, he told William F. McLean, China Lake's civilian technical director, that "I'm here to support you."[166] Similarly, Maj. Gen. James F. Phillips, who had been Air Force secretary on the staff of the Research and Development Board, was subsequently a highly successful commander of the Air Force Cambridge Research Center. In contrast, his successor, within a year of assuming command, initiated a reorganization that shifted the "technical deputy" position (held by a civilian) in the line of the organization to the staff as "technical director." Shortly thereafter the new commander abolished the position entirely. As a result, the technical director and the three senior civilians in each of the operating directorates resigned.[167]

Whether or not military officers were adept at working with civilians, the fact remained that the former occupied most of the top jobs in support fields such as acquisition. Civilians found the preferment of officers for these posts, regardless of their qualifications, especially rankling. A long and thoughtful letter written by R. D. Sheeline, on the occasion of his resignation from the Navy's Bureau of Ordnance in 1955, illustrates how strongly many civilians felt about such discrimination. Sheeline, who in addition to his civil service position had also been president of the Association of Engineers and Scientists of the Bureau of Ordnance, described the situation existing at the bureau:

> Top level jobs civilians aspire to are filled by Naval officers.
>
> There is no civilian in a position of responsibility and authority equivalent to positions of top engineers and scientists in industry.
>
> Many civilians find themselves subordinate to military personnel who have less experience, are less qualified, or are less able than they are.

Sheeline wanted to establish a “military-civilian partnership” at the bureau in which military and civilians were interleaved in the organization’s command line:

> Let’s form a team where we make the best use of our people. . . . Military training does not make one best qualified for directing research and development, production, or supply functions any more than it makes one best suited for legal, contractual or financial functions. Look at it the other way. How would any good Naval officer like to serve on a ship commanded by a man who spent, say, the last ten years, designing fuzes?[168]

By itself, Sheeline’s letter does not mean much. The history of bureaucracy is littered with critical resignation letters, even constructive ones, from unhappy employees. Even if the charges were true, however, the prospects for civilians may have been much brighter in the other services.[169] But investigations conducted during the 1950s suggested that Sheeline’s particular experience was not unique. The Hoover Commission, for example, found that one of the reasons the Defense Department was unable to make full use of available talent and ability was due to the traditional practice of “depriving civilians of access to many key positions of predominantly business management character, on the grounds that such positions must be reserved for the training of military executives or that background in military operations is a prerequisite.”[170]

Addressing Problems of the Acquisition Workforce

Examinations of the acquisition workforce during the 1950s presented recommendations intended to create a corps of competent military and civilian acquisition specialists in each of the services. With respect to officers, they urged the Defense Department to severely restrict or entirely forego the practice of assigning officers from other military specialties to acquisition positions; to rotate officer acquisition specialists through assignments in that field only; to prescribe tour lengths of three to five years; to institute carefully designed career development programs; to ensure more equitable promotion opportunity for acquisition specialists to the highest ranks; and to permit officers not selected for promotion to continue in the service. Suggestions for civilians included increases in pay and in the number of high-grade civil service positions; the institution of career development programs; and access to all management positions, except those with criteria clearly establishing a requirement for a military officer.[171]

OSD responded positively to evaluations of the department's personnel policies and practices. Following Rear Admiral Strauss' reports during the Korean War, the secretary of defense issued a directive requiring each military department to establish a program to recruit and train qualified military and civilian personnel in the areas of procurement, production, and supply. The directive also stated that "[r]otation, promotion, and assignment policies within each military department will be adapted to assure the most effective use of trained personnel within these areas."[172] The Riehlman subcommittee report, critical of the discriminatory treatment often experienced by civilian scientists and engineers, generated a polite reply from Assistant Secretary of Defense for Research and Development Quarles. He agreed that military-civilian relationships should be improved and indicated that the department was studying the issues the subcommittee had raised.[173]

Of all the studies bearing on the acquisition workforce during the 1950s, those published by the Hoover Commission had the most significant policy impact. During 1956 and 1957, OSD issued guidance designed to correct some of the major deficiencies identified in those studies. In response to the commission's criticism of officer rotation practices, Secretary of Defense Wilson required the military departments to prescribe a three-year tour, and four years "where it is possible," for officers "occupying important management and specialist positions in the support activities in the Continental United States."[174] To emphasize the importance of civilian career development programs, Wilson reinforced an earlier instruction from the Office of the Assistant Secretary of Defense for Manpower, Personnel, and Reserve requiring their establishment, with a directive (in theory, directives carried more weight than instructions since they were signed by the secretary of defense).[175] To establish a basis for affording civilians a greater opportunity to hold top management jobs in support activities, OSD first requested that the military departments inventory the positions.[176] Based on partial results of the survey, the secretary of defense then issued a directive specifying that positions be designated as either "military" or "civilian" and that occupants of those positions, whether military or civilian, be qualified by training and experience.[177]

Policy proclamation was one thing, policy implementation entirely another. The 1952 directive had required the military departments to develop a competent body of military and civilian procurement specialists. In mid-1955, however, the Hoover Commission found that the services followed practices that were barriers to achieving this objective. These included denying civilians access to top management positions; failing to provide civilians with the same educational and training opportunities offered to the uniformed military, and as a result, chances for career broadening; and not making the best use of qualified officer specialists in procurement and other support fields.[178]

Similarly, the services either opposed or dragged their feet in implementing the directives issued in the mid-1950s that resulted from the Hoover Commission's recommendations. They objected, without success, to the 1957 directive on the staffing of military and civilian management positions in support activities. In their view, it usurped the principle that the military departments, while subject to policies established by OSD, were to be separately administered—in this case an attempt by OSD to dictate the operation of their individual personnel programs.[179]

Progress in developing civilian career programs in acquisition was extremely slow. In mid-1961, reports from the services revealed that such programs had hardly gotten off the ground. In the Army, seven service-wide civilian career programs were operating, but only one of these, supply management, was acquisition related. Programs in the sciences and engineering, procurement, and inspection, were still under development.[180] The Navy reported that much planning was under way, but it could also claim only one acquisition career program—contract negotiator.[181] The Air Force had several relevant programs—the physical sciences, engineering, procurement, and supply—but all were at the air base or other installation level.[182] In 1965, Secretary of Defense McNamara would finally direct the assistant secretary of defense for manpower to establish a department-wide "Civilian Procurement Career Management Program."[183]

Judged by reports from OSD, each service appeared to have "saluted smartly" with respect to Secretary of Defense Wilson's directive on curtailing excessive rotation of officers through key positions. According to the Robertson committee's follow-up report, the Navy had taken action to ensure that tours for program managers and project officers would be at least three years for line officers and four years for engineering duty officers. For its part, the Air Force prescribed a minimum three-to-five year tour for officers occupying positions in research and development and four years for those in other materiel jobs. The secretary of the Air Force also requested that the best qualified project management specialists be assigned to the most important billets, and that the decision to rotate a key manager would be taken only at the command level with full adherence to the minimum three-year tour requirement. The Army hedged slightly, stating that the tour length for its project officers would be "sufficient to insure proper continuity of the project."[184] Gus Lee, staff director for manpower utilization in OSD, perhaps with intentional ambiguity, informed a House Armed Services subcommittee in 1958 that tours of duty for officers in science and engineering assignments "may be 3 or more years."[185] Over the course of ensuing decades, however, study after study would demonstrate that, despite such claims, the services did not pay much attention to policies regarding tour lengths.[186]

The services sometimes portrayed OSD's personnel policies as a violation of the division of powers between the secretary of defense and the military departments that had been established by the National Security Act of 1947. But their reluctance to accept those policies stemmed at bottom from the desire to preserve traditional personnel systems that ensured the dominance of officers from the combat arms. The services believed that to prevail in war the nation's fighting forces must be led by officers experienced in the conduct of military operations, preferably officers tested in combat. Consequently, promotion boards favored such officers, and assignment policies aimed at preparing them to assume responsibilities at increasingly higher organizational echelons and acquire some experience in career fields other than their own operational specialty.

The preferment of combat arms officers for promotion and assignment, combined with the fact that high-level staff positions were much more numerous than comparable positions in operations, meant sharply reduced opportunities for officers (as well as civilians) specializing in support areas such as acquisition. This, as we have seen, drew the attention of Congress and others, such as the Hoover Commission, that were concerned about government economy and efficiency. To its credit, OSD pushed forward policies, sometimes opposed by the services, that sought to strike a balance between the requirement for a "generalist" leadership experienced in military operations and the increasing need for officer specialists qualified to oversee complex and expensive military programs. On the other hand, little change resulted because OSD failed to enforce those policies, leaving the services free to pursue their traditional personnel priorities.

* * * * *

In 1953, Dwight Eisenhower entered the presidency determined to strengthen the authority of the secretary of defense. Charles Wilson, his first choice for that office, put forward an organizational structure designed to achieve that objective: centralized policy direction from a secretary of defense assisted by nine assistant secretaries to be executed by the services operating in a decentralized framework. It did not succeed. The failure was most apparent in the realm of acquisition. Competing missions, overlapping responsibilities, and personal ambitions prevented the assistant secretaries of research and development and applications engineering from producing unified policy. This fragmentation undermined the secretary of defense's authority and enabled the services to pursue costly and duplicative weapon programs, particularly in the guided missile field.

Under pressure from the president to gain control of service weapons programs, Secretary of Defense Wilson and Neil McElroy, his successor, initiated a series of organizational changes primarily affecting research and development—the establishment of the OSD Ballistic Missiles Committee, the post of director of guided missiles, the Advanced Research Projects Agency, and, through the

Department of Defense Reorganization Act of 1958, the position of the director of defense research and engineering—that not only bolstered the authority of the secretary of defense but also gave the office an unprecedented operating role. But by the end of the Eisenhower administration, this power had only begun to be tapped. Its realization awaited a determined leadership equipped with analytical tools enabling OSD to challenge the powerful service bureaucracies.

Most often during these years, OSD was reluctant to force compliance with recommendations or policies that intruded into areas traditionally under service control. Thus, implementation of the Robertson committee's suggestions for shortening the aircraft acquisition cycle or of the directives designed to improve the competence and stability of the acquisition workforce was left up to the services. Without follow up from OSD, well-intentioned policies could be easily ignored, circumvented, carried out halfheartedly, or overwhelmed by bureaucratic inertia.

Endnotes

1. The best history of Sputnik's impact is Robert A. Divine, *The Sputnik Challenge: Eisenhower's Response to the Soviet Satellite*. For the connection of the Soviet and American satellite programs to the International Geophysical Year, see Walter A. McDougall, *The Heavens and the Earth: A Political History of the Space Age*, 59-62, 129-31.
2. James R. Killian, Jr., *Sputnik, Scientists, and Eisenhower: A Memoir of the First Special Assistant to the President for Science and Technology*, 7.
3. David L. Snead, *The Gaither Committee, Eisenhower, and the Cold War*, 139.
4. For the report of the Gaither committee, named for its chairman, businessman H. Rowan Gaither, Jr., see Security Resources Panel of the Science Advisory Committee, *Deterrence and Survival in the Nuclear Age*, Washington, D.C., 7 November 1957, 7, in U.S. Congress, Joint Committee on Defense Production, *Deterrence and Survival in the Nuclear Age (The "Gaither Report" of 1957).*
5. Undoubtedly one reason Eisenhower remained unruffled was that intelligence provided by the high-altitude U–2 reconnaissance aircraft showed the Soviet ICBM program to be in its early stages, not much further along than the U.S. effort, and, in any case, far from achieving an operational capability. The Gaither committee had not been given access to this information. See Divine, *Sputnik Challenge*, 41.
6. Dwight D. Eisenhower, "Annual Message to the Congress on the State of the Union," 9 January 1958, *Public Papers of the Presidents of the United States: Dwight D. Eisenhower, 1958*, 2, 4, 7-8.
7. For Eisenhower's view of the relationship between military security, the economy, and freedom, see Alex Roland, "The Grim Paraphernalia: Eisenhower and the Garrison State," in *Forging the Shield: Eisenhower and National Security for the 21st Century*, ed. Dennis E. Showalter, 19; Gerard Clarfield, *Security with Solvency: Dwight D. Eisenhower and the Shaping of the American Military Establishment*, xi, 1-3; and Snead, *Gaither Committee*, 7-8, 15-20, 41, 190-91.
8. The term was shorthand for the Eisenhower administration's reassessment of the nation's defense requirements undertaken in 1953.
9. Other New Look objectives were to redeploy U.S. forces stationed in the Far East and Europe to the Western Hemisphere where they would form a strategic reserve; to defend North

America against air attack with integrated land, sea, and air forces; to assist allies in providing for their own defense by supplying a nuclear shield and other materiel support; and to maintain a mobilization base sufficient for general war. See Richard M. Leighton, *Strategy, Money, and the New Look, 1953–1956*, 38-39, 188-89, 209, 243, 673-74.
10. Ibid., 47, 259.
11. Table 8 (FY 1952 Appropriations), and table 12 (FY 1953 Appropriations), in Doris M. Condit, *The Test of War, 1950–1953*, 259, 284.
12. Table 1 (Congress and the FY 1954 Defense Budget), in Leighton, *New Look*, 113. Congress eventually appropriated $34.3 billion.
13. Table 1 (Total Federal Outlays, FY 1945–2009), in Historical Office, Office of the Secretary of Defense, *Department of Defense Key Officials, 1947–2004*, 80.
14. Robert J. Watson, *Into the Missile Age, 1956–1960*, 759.
15. Table (Active Duty Military Personnel, 1940–1997), in Roger R. Trask and Alfred Goldberg, *The Department of Defense, 1947–1997: Organization and Leaders*, 171. During the same period, the Department of Defense's civilian workforce dropped from slightly over 1.5 million in FY 1954 to just under 1.2 million in FY 1961. See table (Defense Civilian Work Force, 1940–1997), ibid., 173.
16. Table 8 (Actual Force Levels of U.S. Armed Forces: 1952–1956), in Robert J. Watson, *The Joint Chiefs of Staff and National Policy, 1953–1954*, 84; Byron R. Fairchild and Walter S. Poole, *The Joint Chiefs of Staff and National Policy, 1957–1960*, 40; and Watson, *Missile Age*, 341.
17. Based on the budget tables in Leighton, *New Look*, 113, 254, 362, 629; and Watson, *Missile Age*, 100, 153, 320, 358.
18. J. C. Hopkins and Sheldon A. Goldberg, *The Development of Strategic Air Command, 1946–1986*, 42, 89. In 1949, beginning with the B–36E, two turbojets were mounted under each wing of the aircraft to supplement its six piston engines. See Marcelle Size Knaack, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems*, Vol. II, *Post–World War II Bombers, 1945–1973*, 4, 54-55.
19. David A. Rosenberg, "American Postwar Air Doctrine and Organization: The Navy Experience," in *Air Power: Promise and Reality*, ed. Mark K. Wells, 194-96; and Jerry Miller, *Nuclear Weapons and Aircraft Carriers: How the Bomb Saved Naval Aviation*, 90-109.
20. Watson, *Missile Age*, 368, 373-75, 377-78; Jacob Neufeld, *Ballistic Missiles in the United States Air Force, 1945–1960*, 186, 208-09, 222-24; and Office of the Historian, *SAC Missile Chronology, 1939–1988*, 23-27. The range of later versions of the Polaris was 2,500 nautical miles.
21. Leighton, *New Look*, 39, 64, 444, 661-72; and Watson, *Missile Age*, 162-65.
22. Leighton, *New Look*, 638-39; and Watson, *Missile Age*, 421-30.
23. Watson, *Missile Age*, 157, 167-69.
24. Ibid., 174; and Clifford C. Furnas, "Research and Development in the Armed Forces," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 20 December 1957, 14, NDU Library.
25. Leighton, *New Look*, 36-38; and Clarfield, *Security with Solvency*, 4-6, 11-19, 25-30.
26. Leighton, *New Look,* 437-45.
27. See, for example, Clarfield, *Security with Solvency*, 173. Other historians maintain that Eisenhower and Wilson generally encouraged competing missile programs among the services as a way to produce the most effective systems. For this argument, see Charles S. Maier's introduction to George B. Kistiakowsky, *A Scientist at the White House: The Private Diary of President Eisenhower's Special Assistant for Science and Technology*, xxxv; Watson, *Missile Age*, 164; and especially David Milobsky, "Leadership and Competition: Technological Innovation and Organizational Change at the U.S. Department of Defense, 1955–1968," Ph.D. diss., Johns Hopkins University, 1996, 10, 18, 28-31, 37, 43, 71, 309-11. Milobsky's argument rests almost entirely on the IRBM case.
28. Leighton, *New Look*, 445, 677.

29. Memorandum of Discussions at the 293d and 294th Meetings of the National Security Council, August 16 and August 17, 1956 [meeting of 17 August], in *Foreign Relations of the United States, 1955–1957*, Vol. XIX, *National Security Policy*, ed. William Klingaman, David S. Patterson, and Ilana Stern, 356. At the end of July 1956, the Egyptians had seized control of the privately owned Suez Canal. In October, a British, French, and Israeli invasion of Egypt to retake the canal raised the prospect of Soviet intervention and caused a crisis in U.S. relations with Great Britain and France.
30. Interview of James R. Killian, Jr., 18 July 1975, by Richard J. Barber Associates, Inc., and cited in *The Advanced Research Projects Agency, 1958–1974*, a study prepared for the Advanced Research Projects Agency under Contract No. MDA 903-74-C0096, II-6.
31. Furnas, "Research and Development in the Armed Forces," 13.
32. Other major aspects of the 1958 reorganization involved clarifying the command relationships from the president and the secretary of defense to the unified and specified commands; increasing the power of the chairman of the Joint Chiefs of Staff and the size of the Joint Staff; clarifying the relationships between the Joint Chiefs of Staff and the Office of the Secretary of Defense and between the Joint Chiefs of Staff and the unified and specified commands; and enhancing the authority of the secretary of defense over the military departments. For a concise description and analysis of the 1953 and 1958 reorganizations, see Trask and Goldberg, *Department of Defense*, 21-31.
33. Leighton, *New Look*, 5-6, 16-17, 19-20, 71, 676; and Watson, *Missile Age*, 6-7.
34. Memo, C. E. Wilson for Mr. Nelson A. Rockefeller, 26 February 1953, folder Wilson Letter to Nelson Rockefeller, 26 February 1953, box 517, Subject Files (Organization), OSD/HO.
35. Leighton, *New Look*, 18, 23; and Milobsky, "Leadership and Competition," 37-39.
36. For the texts of the Rockefeller Committee report and Reorganization Plan No. 6, see *The Department of Defense: Documents on Establishment and Organization, 1944–1978*, ed. Alice C. Cole, Alfred Goldberg, Samuel A. Tucker, and Rudolph Winnacker, 126-49, 157-58. For analysis of both, see Leighton, *New Look*, 21-34. Some members of the House of Representatives sought to derail parts of Reorganization Plan No. 6 that strengthened the power of the chairman of the Joint Chiefs of Staff in relation to the corporate JCS. Their effort, which generally reflected the Navy's opposition to increased centralization in the Department of Defense, failed. See Jeffrey G. Barlow, *From Hot War to Cold: The U.S. Navy and National Security Affairs, 1945–1955*, 341-48.
37. Leighton, *New Look*, 32; and Watson, *Missile Age*, 3.
38. In addition to these four positions, Reorganization Plan No. 6 established two other new assistant secretaries of defense: legislative and public affairs, and health and medical. The already established assistant secretary of defense posts were retained from the previous organizational setup: comptroller, international security affairs, and manpower and personnel.
39. Statement of Deputy Secretary of Defense Roger M. Kyes before the House Committee on Government Operations on Reorganization Plan No. 6, 17 June 1953, 4, folder 1, box 583, entry 341 (Research and Development Board), RG 330; and Press Release No. 836-53, Office of Public Information, Department of Defense, address of Charles S. Thomas, Assistant Secretary of Defense (Supply and Logistics), to the Armed Forces Chemical Association, Chicago, Illinois, 9 September 1953, 1, folder Directives and Procedural Memos, box 81, entry 220 (Historical Manuscripts and Papers Containing Background Data Re: Munitions Board and Industrial Mobilization Programs, 1947–1953), RG 330; and chap. 3 in this volume.
40. "The Battle for Control of the R&D Process" is the title of chap. 3 in Glen R. Asner, "The Cold War and American Industrial Research," Ph.D. diss., Carnegie Mellon University, 2006. I am grateful to Dr. Asner for sharing his excellent scholarship and perceptive insights into postwar research and development with me.
41. Herbert F. York, *Race to Oblivion: A Participant's View of the Arms Race*, 84.
42. Department of Defense Directive 5128.7 (Responsibilities of the Assistant Secretary of Defense [Research and Development]), 12 November 1953, folder R&D Organization 1958,

box 832, Subject Files (Research and Development, 1953–1960), OSD/HO.

43. Press Release No. 1007-53, Office of Public Information, Department of Defense, address of Donald A. Quarles, Assistant Secretary of Defense (Research and Development), to the Institute of Industrial Research, Detroit, Michigan, 26 October 1953, 4-5, folder R&D Speeches, 1953–1955, box 838, Subject Files (Research and Development, 1953–1960), OSD/HO; Subcommittee on Research Activities in the Department of Defense and Defense Related Agencies of the Committee on Business Organization of the Department of Defense, *Report on Research Activities in the Department of Defense and Defense Related Agencies*. Prepared for the Commission on Organization of the Executive Branch of the Government, April 1955, 12-15 [hereafter Hoover Commission Subcommittee on Research Activities report]; and Melvin Bell, "The Office of the Director of Defense Research and Engineering: Its Organization and Administration," Ph.D. diss., American University, 1960, 26-30. As of January 1954, coordinating committees had been established for atomic energy, biological and chemical warfare, electronics, equipment and supplies, general sciences, guided missiles, marine craft and underwater ordnance, medical sciences, ordnance, personnel and training, piloted aircraft, special operations, and tanks, land and amphibious vehicles. The technical advisory panels were in the fields of aeronautics, atomic energy, biological and chemical warfare, electronics, fuels and lubricants, general sciences, medical sciences, ordnance, personnel and training research, and research in special operations. (Bell, 28).

44. "The Rockefeller Committee—11 February–11 April 1953," in *Department of Defense: Documents on Establishment and Organization*, 139.

45. Department of Defense Directive 5129.1 (Responsibilities of the Assistant Secretary of Defense [Applications Engineering]), 8 December 1953, folder Applications Engineering, 1953–1957, box 833, Subject Files (Research and Development, 1953–1960), OSD/HO.

46. Some have attributed the idea for the applications engineering position to Wilson and to his manufacturing experience at General Motors. In his late February 1953 letter to the Rockefeller Committee, Wilson suggested the need for an assistant secretary for "engineering" and described the job's general functions. (Memo, C. E. Wilson for Mr. Nelson A. Rockefeller, 26 February 1953, folder Wilson Letter to Nelson Rockefeller, 26 February 1953, box 517, Subject Files [Organization], OSD/HO.) Strong reinforcement for such a post also came from Eisenhower. On 3 March 1953, the president wrote Wilson of his concern that since World War II weapon designs had become increasingly complex and costly: "I think I would be the last one to deprive a fighting man of the best and most modern weapons we can produce. But cost, speed of production and ease of maintenance must all be considered in every decision on military equipment." (Memo, D. D. E. [Dwight D. Eisenhower] for the Secretary of Defense, 3 March 1953, folder Eisenhower Papers, 1953, box 9, Richard D. Leighton materials collected for preparation of *New Look*, deposited with National Archives and Records Administration. The original document is from Administration File, Eisenhower Papers as President, 1953–1961 [Whitman File], Dwight D. Eisenhower Library, Abilene, Kans.)

47. In 1956, the position's name was changed (but without altering its functions) to the assistant secretary of defense for engineering. See Department of Defense Directive 5129.4 (Responsibilities of the Assistant Secretary of Defense [Engineering]), 4 October 1956, folder Applications Engineering, 1953–1957, box 833, Subject Files (Research and Development, 1953–1960), OSD/HO.

48. Memo, Frank D. Newbury, Assistant Secretary of Defense (Applications Engineering), for Deputy Secretary of Defense [Roger M. Kyes], 4 January 1954, sub: Report of Assistant Secretary of Defense (Applications Engineering) for December 1953, folder Reports of Directorates, box 10, entry 1014 (Office of the Assistant Secretary of Defense [Applications Engineering]; Office of the Director of Defense Research and Engineering, Policy Papers, 1953–1957), RG 330.

49. Leighton, *New Look*, 71.

50. Press Release No. 387-53, Office of Public Information, Department of Defense, address of

Deputy Secretary of Defense Roger M. Kyes to the U.S. Chamber of Commerce, Washington, D.C., 27 April 1953, 2; and Press Release No. 1151-53, Office of Public Information, Department of Defense, address of Deputy Secretary of Defense Roger M. Kyes, to the Adcraft Club, Detroit, Michigan, 4 December 1953, 1-2: both in folder Kyes, 1953, box 17, Biographical Files (Deputy Secretaries, 1951–1956), OSD/HO.
51. Statement by Deputy Secretary of Defense Roger M. Kyes before the House Committee on Government Operations on Reorganization Plan No. 6, 17 June 1953.
52. Other accelerated programs that ran into similar difficulties were several of the Army's tanks (chap. 4), the Air Force's F–102 interceptor (chap. 5), and the B–47 bomber (chap. 6). The Wilson Defense Department also cited the Air Force's F–84F and F–101A aircraft and the Navy's A2D, A2U, and F3H–1 aircraft as examples of an alleged "buy—then fly them" fallacy. See draft statement for Sen. Leverett Saltonstall (R-Mass.), 15-16, atch to memo, Max Lehrer, Office, Assistant Secretary of Defense (Comptroller), for Robert T. Ross, Assistant Secretary of Defense (Legislative and Public Affairs), 30 April 1956, folder Symington Committee, box 38, Records, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO.
53. Memo, Frank D. Newbury, Assistant Secretary of Defense (Applications Engineering), for Deputy Secretary of Defense [Roger M. Kyes], 6 April 1954, sub: Report of the Assistant Secretary of Defense (Applications Engineering) for March 1954, folder Reports of Directorates, box 10, entry 1014, RG 330.
54. Department of Defense, Office of Public Information, Minutes of Press Conference, Secretary of Defense Charles E. Wilson, 6 March 1956, folder Guided Missiles, 1953–1956, box 842, Subject Files (Research and Development, 1953–1960), OSD/HO.
55. Ltr, Assistant Secretary of the Navy (Air) J. H. Smith, Jr., to Secretary of Defense, 29 November 1954, sub: Planning for Procurement of P6M–1 Aircraft; and memo, Secretary of Defense C. E. Wilson for Secretary of the Navy [Thomas R. Gates, Jr.], 10 December 1954: both in folder 452, Jun.–Dec. 1954, box 62, entry 200B (Office of the Administrative Secretary, Correspondence Control Section, General Correspondence, 1953–1954), RG 330.
56. Department of Defense Directive 4105.10 (Amplification of Policy Governing Award of Initial Production Contracts for Technical or Specialized Military Supplies), 17 March 1955, folder Under Secys and ASDs Remarks on DoD Comments (Prior to Submission to BoB [Bureau of Budget]), box 23, entry 366C (Office of the Assistant Secretary of Defense [Comptroller]; Office of the Director for Plans and Systems; Hoover Commission Files), RG 330.
57. Department of Defense Directive 5129.1 (Responsibilities of the Assistant Secretary of Defense [Applications Engineering]), 8 December 1953 [italics added].
58. Hoover Commission Subcommittee on Research Activities report, 17.
59. Quarles explained the distinction between "old art" and "new art" in a speech in the fall of 1953. The agreement with applications engineering, he said, "provides that in those cases in which the art is well established, or parallels closely civil design, research and development work will be limited to exploratory work through the research or bread-board model stages and that cognizance will pass to Applications Engineering at the stage where final design work can be undertaken. In instances in which advanced technology or new art is involved, the field of research and development is considered to include those activities usually termed basic and exploratory research, applied and supporting research, laboratory and engineering field tests of prototypes, as well as systems analysis and evaluation incidental to such development." See address of Donald A. Quarles to the Institute of Industrial Research, 26 October 1953, 6.
60. Memo, Frank D. Newbury, Assistant Secretary of Defense (Applications Engineering), for Deputy Secretary of Defense [Robert B. Anderson], 8 June 1954, sub: Charter Responsibilities of the Assistant Secretary of Defense (AE), folder 040, R&D, 1954, box 9, entry 200B, RG 330.
61. Attachment to memo, Newbury for Deputy Secretary of Defense, 30 June 1954.
62. Assistant Secretary of Defense (Applications Engineering), "Distribution of FY 1955 Appropriations for Research, Development, and Procurement," 13 July 1954, encl. to ltr, Frank

D. Newbury, Assistant Secretary of Defense (Applications Engineering), to Dr. Mervin J. Kelly, President, Bell Telephone Laboratories, 30 July 1954, folder 040, Applications Engineering, 1954, box 9, entry 200B, RG 330. The actual figures for FY 1955 were: $1.349 billion directly appropriated for research and development; $344 million in indirect research and development costs, such as pay for military personnel; and $1.826 billion that supported development, test, and evaluation from all other appropriation categories, primarily the procurement account. See House of Representatives, 32d Report of the Committee on Government Operations, *Research and Development (Office of the Secretary of Defense)*, 85th Cong., 2d sess., 1958, H. Rpt. 2552, 93.

63. Attachment to memo, Newbury for Deputy Secretary of Defense, 30 June 1954.

64. Memo, Donald A. Quarles, Assistant Secretary of Defense (Research and Development), for Deputy Secretary of Defense [Robert B. Anderson], 27 July 1954, sub: The Research and Development and Applications Engineering Functions, folder 040, R&D, 1954, box 9, entry 200B, RG 330.

65. Memo for discussion, Frank D. Newbury, Assistant Secretary of Defense (Applications Engineering), 31 August 1954, sub: Assignment of Supervisory Responsibility of Development Projects to the Assistant Secretary of Defense (Research and Development) and the Assistant Secretary of Defense (Applications Engineering), folder 040, R&D, 1954, box 9, entry 200B, RG 330; memo, Donald A. Quarles, Assistant Secretary of Defense (Research and Development), for Deputy Secretary of Defense [Robert B. Anderson], 8 September 1954, sub: Organization of R&D/AE with atch memo of discussion, same date, same subject, folder 040, Applications Engineering, 1954, box 9, entry 200B, RG 330; memo, Donald A. Quarles, Assistant Secretary of Defense (Research and Development) and Frank D. Newbury, Assistant Secretary of Defense (Applications Engineering), for Secretary of Defense [Charles E. Wilson] through Deputy Secretary of Defense [Robert B. Anderson], 22 September 1954, sub: Organization of Research and Development and Applications Engineering in the Office of the Secretary of Defense, folder Review of Development Projects, box 9, entry 1014, RG 330; and Department of Defense Instruction 5100.3, 27 October 1954, sub: Clarification of the Relationships of the Assistant Secretary of Defense (Research and Development) and the Assistant Secretary of Defense (Applications Engineering), folder Review of Development Projects, box 9, entry 1014, RG 330.

66. Memo, W. J. McNeil, Assistant Secretary of Defense (Comptroller), for Secretary of Defense, 8 June 1955, McNeil Reading File, RG 330, OSD/HO; memo, C. E. Wilson, Secretary of Defense, for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, Assistant Secretary of Defense (Comptroller), Assistant Secretary of Defense (Applications Engineering), 10 June 1955, sub: Apportionment and Reprogramming Authority for Funds Related to Applications Engineering, folder Apportionment, box 10, entry 1014, RG 330; and Asner, "Cold War and American Industrial Research," 125.

67. In May 1957, Quarles returned to OSD as deputy secretary of defense, serving in that post until his death in May 1959.

68. In the interim between Quarles' departure and Furnas' arrival, John B. Macauley was acting assistant secretary of defense for research and development.

69. Asner, "Cold War and American Industrial Research," 150-52.

70. Memo, John J. Crowley, Director, Guided Missiles; Office, Assistant Secretary of Defense (Applications Engineering), for Mr. Frank D. Newbury, 16 April 1956, sub: Example of Unilateral Action by Research and Development in Area of Joint Applications Engineering Cognizance, folder General, Guided Missiles, box 4, entry 1014, RG 330.

71. Memo, C. E. Wilson, Secretary of Defense, for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, Assistant Secretary of Defense (Comptroller), Assistant Secretary of Defense (AE), Assistant Secretary of Defense (RD), 21 February 1956, sub: Review and Approval of Development Projects, folder Review and Approval of Development Projects, box 9, entry 1014, RG 330; and Asner, "Cold War and American Industrial Research," 153. According to Wilson's memo, applications engineering had responsibility for all projects except

those "that are exclusively of a research or exploratory nature, such as projects whose planned purpose is to explore a field of knowledge in search of new information, to study new concepts that may result in the development of new or improved materiel, or to prove the feasibility of new ideas or principles; and whose purpose and currently planned funding does not provide for development of a complete unit or component for service use."

72. Asner, "Cold War and American Industrial Research," 154-56.

73. Memo, F. T. Hague, Director, Office of Aircraft and Marine Craft, Office of the Assistant Secretary of Defense (Applications Engineering), for G. A. Tucker, Director, Office of Ordnance and Transport Equipment, Office of the Assistant Secretary of Defense (Applications Engineering), 3 April 1956, sub: Dr. Furnas' Proposal of 30 March 1956, folder Aircraft General #1, box 2, entry 1014, RG 330.

74. Memo, C. E. Wilson, Secretary of Defense, for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, Assistant Secretary of Defense (Comptroller), Assistant Secretary of Defense (Applications Engineering), Assistant Secretary of Defense (Research and Development), 24 May 1956, sub: Assignment of Responsibility for Review and Approval of Research and Development Programs and Projects, folder Applications Engineering, 1953–1957, box 833, Subject Files (Research and Development, 1953–1960), OSD/HO; and Asner, "Cold War and American Industrial Research," 156.

75. Asner, "Cold War and American Industrial Research," 157-67.

76. Precedent existed for separate management of missile acquisition. For three years, from the fall of 1950 through the fall of 1953, K. T. Keller, chairman of the board of the Chrysler Corporation and recruited personally by President Truman, had served as director of guided missiles in the Office of the Secretary of Defense. Had he desired the authority, Keller might have exercised control over the services' missile research and development programs, eliminating unnecessary duplication. Keller, however, focused on missile production and left determining requirements for them to the services. See chap. 3 in this volume.

77. Memo, Secretary of Defense C. E. Wilson for Deputy Secretary of Defense, Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, Chairman of the Joint Chiefs of Staff, Assistant Secretary of Defense (Comptroller), Assistant Secretary of Defense (Research and Development), Assistant Secretary of Defense (Applications Engineering), 23 September 1954, sub: Report on Guided Missiles, folder Mr. A. G. Waggoner, box 844, Subject Files (Research and Development, 1953–1960), OSD/HO.

78. Memo, Frank D. Newbury for Deputy Secretary of Defense, 26 January 1955, sub: Proposed Guided Missile Advisory Group, folder Guided Missile Management, 1953–1958, box 842, Subject Files (Research and Development, 1953–1960), OSD/HO.

79. Ibid.

80. Memo, Howard K. Hyde, Fiscal Management Staff, Office of the Assistant Secretary of Defense (Comptroller), for Mr. McNeil, 14 September 1954, sub: A Proposed Approach to the Guided Missiles Survey, folder Guided Missiles, 1953–1954, box 4, Richard D. Leighton materials collected for preparation of *New Look*, deposited with National Archives and Records Administration. The original document is from folder Guided Missiles, box 5, Accession 65A 3552, Records of the Assistant Secretary of Defense (Comptroller), RG 330.

81. Notes, George A. Wyeth, Jr., Special Meeting on Proposed Guided Missiles Advisory Committee, 13 April 1955, ibid. For Quarles' opposition, see memo, Assistant Secretary of Defense (Research and Development) Donald A. Quarles for Deputy Secretary of Defense, 5 January 1955, sub: Guided Missile Organization, folder Guided Missiles, 1955 (1), Richard D. Leighton materials collected for preparation of *New Look*, deposited with the National Archives and Records Administration. (The original document is from folder 470 Guided Missiles, Jan. to June 1955, box 20, Accession 59A-2376, RG 330.); and memo, Assistant Secretary of Defense (Research and Development) Donald A. Quarles for Deputy Secretary of Defense, 16 February 1955, sub: Proposed Guided Missile Advisory Group, folder Guided Missile Management, 1953–1958, box 842, Subject Files (Research and Development, 1953–1960), OSD/HO.

82. Milobsky, "Leadership and Competition," 43.
83. James R. Killian, Jr., president of the Massachusetts Institute of Technology and later President Eisenhower's first special assistant for science and technology, chaired the panel, which included more than 40 distinguished scientists and scientist-administrators. For the influence of the Killian panel and the evolution of the Eisenhower administration's decision to accelerate the ICBM and develop an IRBM, see Leighton, *New Look*, 396-98, 423-45; Watson, *Missile Age*, 159-60; and Divine, *Sputnik Challenge*, 23-25.
84. Watson, *Missile Age*, 160.
85. Ibid., 161, 170. In March 1956, Eger V. Murphree, president of the Esso Research and Engineering Company of Standard Oil of New Jersey, became the special assistant for guided missiles; William M. Holaday, who had been deputy assistant secretary of defense for research and development, succeeded him in April 1957.
86. Ibid., 170. In addition to the Air Force's Atlas and Titan ICBMs and the Air Force's Thor, the Army's Jupiter, and the Navy's Polaris IRBMs, the special assistant for guided missiles became responsible for coordination within OSD of the following programs: the Army's Redstone and other ballistic missiles of equal range; the Air Force's Snark and Navaho and the Navy's Triton cruise missiles; anti-ballistic missiles; and the use and extension of guided missile test ranges.
87. Beginning in February 1957, the Joint Coordinating Committee on Guided Missiles came under the newly established Office of the Assistant Secretary of Defense for Research and Engineering.
88. On 10 October 1957, the day after McElroy took office, the president told him to consider a different management structure for the ICBM and IRBM programs. In a speech to the nation following the launch of the second Sputnik on 4 November, Eisenhower reported that he had instructed McElroy to ensure that the official responsible for the missile effort "is clothed with all the authority that the Secretary himself possesses in this field, so that no administrative or interservice block can occur." See ibid., 139-40, 180-82 (quotation on p. 182).
89. Ibid., 182-83. Quoted material is from Department of Defense Directive 5105.10 (Establishment of a Special Assistant to the Secretary of Defense for Guided Missiles), 27 March 1956, and Department of Defense Directive 5105.10 (Director of Guided Missiles), 15 November 1957: both in folder Guided Missile Management, 1953–1958, box 842, Subject Files (Research and Development, 1953–1960), OSD/HO. William M. Holaday, the special assistant for guided missiles, moved up to become the director of guided missiles.
90. Furnas, "Research and Development," 17-18.
91. Watson, *Missile Age*, 187-91.
92. See Barber and Associates, *Advanced Research Projects Agency*, II: 8-13; and chaps. 5 and 9 in this volume in the series, *History of Acquisition in the Department of Defense*..
93. The National Security Act of 1947 with amendments through 31 December 1958, in "Department of Defense Reorganization Act of 1958—6 August 1958 (72 Stat. 514)," *Department of Defense: Documents on Establishment and Organization*, 204-05.
94. Department of Defense Directive 5129.1 (Director of Defense Research and Engineering), 10 February 1959, file DoD Directives/Instructions, 1953–1960, OSD/HO.
95. "Department of Defense Reorganization Act of 1958—6 August 1958," in *Department of Defense: Documents on Establishment and Organization*, 204; and Watson, *Missile Age*, 288, 361. The Armed Forces Policy Council was chaired by the secretary of defense and also included the deputy secretary of defense, the secretaries of the military departments, the chairman of the Joint Chiefs of Staff, the chiefs of staff of the Army and the Air Force, and the chief of naval operations. The Joint Secretaries' membership was entirely civilian and identical to that of the Armed Forces Policy Council except that it also included the under secretaries of the military departments and the assistant secretary of defense for international security affairs.
96. Asner, "Cold War and American Industrial Research," 168-71; and Herbert F. York and G. Allen Greb, "Military Research and Development: A Postwar History," *Bulletin of the Atomic*

Scientists 33, no. 1 (January 1977): 24.
97. Watson, *Missile Age,* 288, 362. On 1 July 1959, the deputy secretary of defense took over chairmanship of the OSD Ballistic Missiles Committee.
98. See Bell, "Office of the Director of Defense Research and Engineering," 71, 77-80, 93-94, 130. For R&D planning carried out by the Research and Development Board, see chap. 2 in this volume in the series, *History of Acquisition in the Department of Defense*.
99. Myron G. Myers, John A. Ciucci, Gerald T. Kelley, and Donna J. S. Peterson, *Acquisition Streamlining: Barriers to Implementation of Prior Recommendations, A Report to the Defense Science Board's Acquisition Streamlining Task Force*, Vol. I, 3-2. See also Jacques S. Gansler, *Affording Defense*, 172-73.
100. In preparing its report, the task force identified 15 major studies that made recommendations concerning development cycle time. The task force defined development as starting with the preparation of a design through the delivery of the first operational production article and based its estimate of the increase in development time on data from 150 program histories. See ibid., 3-1 and app. B (Historical Cycle Time and Legislative Trend Analysis).
101. Up to this time, among the services, the Air Force had paid the most attention to compressing the weapons procurement cycle. *The Weapons Acquisition Process: An Economic Analysis*, Merton J. Peck's and Frederic M. Scherer's pioneering study, makes several references to the work of the Robertson committee. The committee is also the subject of an unpublished paper, authored by Ronald Hoffman for the OSD Historical Office.
102. In the terminology employed by the committee, "project" officers in the Air Force and Navy managed weapons "projects" or "programs." During the period the committee conducted its work, the Bureau of Aeronautics introduced "program managers" into its organizational structure.
103. Memo, Maj. Gen. John A. Samford, Director of Intelligence, Headquarters, U.S. Air Force, for Director, Office of Information Services, Office of the Secretary of the Air Force, 16 May 1955, sub: Unclassified Comments on Practice Fly-Bys for May Day 1955, folder Aircraft 1955, box 74, Twining Papers, LC; memo, Adm. Arthur Radford, Chairman, Joint Chiefs of Staff, for Secretary of Defense, 16 May 1955, sub: A Comparison of the Heavy and Medium Jet Bomber Programs of the USSR versus Similar Programs of the United States, folder DDEL 1956-I (January–June), box 13, Richard D. Leighton materials collected for preparation of *New Look*, deposited with National Archives and Records Administration. The original document is from folder Russia 452, box 3, Secretary of Defense Subject Files, 1955, Accession 59A-2376, RG 330; and Leighton, *New Look*, 379-84. Bad weather prevented flyovers for the May Day parade in 1955, but new aircraft were observed practicing for the event.
104. Leighton, *New Look*, 388-89, 396.
105. Memo, C. E. Wilson, Secretary of Defense, for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, Assistant Secretary of Defense (Comptroller), Assistant Secretary of Defense (Supply and Logistics), Assistant Secretary of Defense (Research and Development), Assistant Secretary of Defense (Applications Engineering), 30 September 1955, sub: Ad Hoc Group to Study Department of Defense Methods and Procedures of Research, Development, Procurement, and Production, encl. to ltr, Reuben B. Robertson, Jr., Deputy Secretary of Defense, to Secretary of Defense, 9 February 1957, folder Research and Development (General), 1956–1959, box 832, Subject Files (Research and Development, 1953–1960), OSD/HO.
106. The Robertson committee was to investigate only manned, fixed-wing Air Force and Navy systems; a separate study was launched to survey helicopter acquisition. Despite this limited charter, the Army considered many of the group's findings relevant to the acquisition of a variety of systems in that service. See app. B (Department of Army Actions to Reduce Time from Concept to Inventory of Materiel Used by the Army in the Field) to encl. (*Maximum Improvement in Air Weapon Systems in Minimum Time: Summary of Actions Taken to Reduce the Time Required for Research, Development, Procurement, and Production of Manned Aircraft*

Weapon Systems, 8 February 1957) to ltr, Robertson to Secretary of Defense, 9 February 1957.
107. Ad Hoc Study Group, *Manned Aircraft Weapon Systems: A Program for Reducing the Time Cycle from Concept to Inventory*, July 1956, 7 [hereafter Ad Hoc Study Group report], box 10, Records of Booz, Allen & Hamilton, Inc., 1946–1973, OAB, NHC.
108. Preliminary Report Prepared for the Ad Hoc Study Group, *Manned Aircraft Weapon Systems: Program for Reducing the Time Cycle from Concept to Inventory*, June 1956, iv-v, encl. to memo, David L. Chewning, Staff Director, Ad Hoc Aircraft Study Group, for Assistant Secretary of Defense (Comptroller), Assistant Secretary of Defense (Applications Engineering), Assistant Secretary of Defense (Supply and Logistics), Assistant Secretary of Defense (Research and Development), Under Secretary of the Army, Under Secretary of the Navy, Under Secretary of the Air Force, 29 June 1956, sub: Preliminary Report to the Ad Hoc Group on Manned Aircraft Weapon Systems, folder S-1750-56, box 5, entry 160A (Assistant Secretary of Defense, Supply and Logistics, Secret Files, 1956), RG 330.
109. Ad Hoc Study Group report, 19.
110. Ibid., 14-15.
111. Ibid., 12-13, 15-18. The committee reported that most information available to requirements planners related to technical feasibility and very little to strategy, doctrine, and enemy capabilities. With respect to information bearing on technical feasibility, the committee indicated that requirements planners distrusted data provided by the services' research and development agencies and tended to rely on industry estimates with a "heavy sales interest." They also lacked knowledge of subsystem availability and limitations. Additionally, the committee found that requirements staffs did not use tactical gaming or field experiments to establish a weapon's potential capabilities.
112. Ibid., 19-21 (quotation, 20).
113. Ibid., 33-35, 38-40.
114. Ibid., 27-31, 33-34, exhibits 7 and 8.
115. Ibid., 31-33, exhibit 9. In late 1955, as previously described, Secretary of Defense Wilson established a vertical organizational structure, headed by the OSD Ballistic Missiles Committee, to streamline management of the long-range ballistic missile programs. Under this arrangement, Maj. Gen. Bernard A. Schriever, commander of the Western Development Division of the Air Force's Air Research and Development Command and manager of the Atlas and Titan ICBM and the Thor IRBM programs, reported to the OSD Ballistic Missiles Committee through only one intervening layer, the Air Force's Ballistic Missiles Committee headed by the secretary of the Air Force. Under normal procedures, Schriever would have first reported to the Air Research and Development Command and then to the Air Staff prior to communicating with any higher-level bodies. See also chap. 9 in this volume in the series, *History of Acquisition in the Department of Defense*.
116. Ad Hoc Study Group report, 38, 41-42, exhibits 11 and 12.
117. Ibid., 44.
118. Ibid., 47-48.
119. Ibid., 48-50.
120. Ibid., 51-53.
121. Ibid., 54-56, 67-69.
122. Ibid., 57-58, 62-65.
123. Ibid., 58-60.
124. Ltr, Reuben B. Robertson, Jr., Deputy Secretary of Defense, et al., to Secretary of Defense Charles E. Wilson, 25 July 1956, sub: Ad Hoc Study Group for Manned Aircraft Weapons Systems, ibid.
125. Memo, H. A. Damminger, Executive Assistant, Office of the Assistant Secretary of Defense (Supply and Logistics), for R. C. Lanphier, Jr., Assistant Secretary of Defense (Supply and Logistics), 14 August 1956, sub: Report of Attendance at Armed Forces Policy Council Meeting, folder S-2173-56, box 5, entry 160A, RG 330. During a speech in mid-November,

Robertson made clear the voluntary nature of the report's recommendations, noting that the military departments would execute its action objectives "in a manner best suited to each situation." See address by Reuben B. Robertson, Jr., Deputy Secretary of Defense, before the New York Group of the National Security Industrial Association, New York, New York, 15 November 1956, in *Public Statements of Reuben B. Robertson, Jr., Deputy Secretary of Defense, 5 August 1955 thru 25 April 1957*, 283, OSD/HO.

126. For the "bomber gap" controversy see Leighton, *New Look*, 379-98, 631-53, 678; and Watson, *Missile Age*, 315, 351, 408. Like the supposed "missile gap," no "bomber gap" actually existed.

127. Press Release No. 907-56 (Study Group on Manned Aircraft Weapon Systems Submits Recommendations to Secretary of Defense), Office of Public Information, Department of Defense, 31 August 1956, folder Aircraft 1956, box 854, Subject Files (Research and Development, 1953–1960), OSD/HO.

128. *Maximum Improvement of Air Weapon Systems in Minimum Time: Summary of Actions Taken to Reduce the Time Required for Research, Development, Procurement, and Production of Manned Aircraft Weapon Systems*, 8 February 1957 [hereafter *Summary of Actions Taken*, February 1957], encl. to ltr, Robertson to Secretary of Defense, 9 February 1957.

129. Press Release No. 161-57 (Defense Secretary Announces Results of Aircraft Time Cycle Project), Office of Public Information, Department of Defense, 21 February 1957, folder Aircraft, 1957, box 854, Subject Files (Research and Development, 1953–1960), OSD/HO.

130. Ltr, Reuben B. Robertson, Jr., Deputy Secretary of Defense, to Secretary of Defense, 9 February 1957, folder Aircraft, 1957, box 854, Subject Files (Research and Development, 1953–1960), OSD/HO.

131. Watson, *Missile Age*, 136, 141, 150, 305-06, 831 (note 109). For the Preparedness Investigating Subcommittee statement listing the seventeen recommendations, see Preparedness Investigating Subcommittee of the Senate Committee on Armed Services, *Inquiry into Satellite and Missile Programs: Hearings before the Preparedness Investigating Subcommittee of the Committee on Armed Services United States Senate (Reports of Secretary of Defense on Accomplishments of Defense Department on Recommendations of the Preparedness Subcommittee, February 26, April 3, and July 24, 1958)*, pt. 3, 85th Cong., 1st and 2d sess., 2358-2476. (The committee's January statement listing the recommendations is reprinted on pp. 2427-30.)

132. Memo, Donald A. Quarles, Deputy Secretary of Defense, for Secretary of the Navy, 18 February 1958, box 10, BAH records, OAB, NHC. My research did not uncover a progress report from the Air Force (although one was surely requested) or a letter similar to the one that Quarles sent to the secretary of the Navy.

133. Report attached to ltr, Vice Adm. R. E. Dixon, Chief, Bureau of Aeronautics, to Assistant Secretary of the Navy (Air) via Chief of Naval Operations, 26 March 1958, sub: Robertson Committee Report; Submission of Follow-up Report of Implementation, encl. to memo, Assistant Secretary of the Navy (Air) Garrison Norton for Secretary of Defense, 1 April 1958, box 10, BAH records, OAB, NHC [hereafter Navy report of 26 March 1958].

134. Ibid.

135. *Summary of Actions Taken*, February 1957, 9-10. Wilson was not willing to force the services to implement the Robertson committee's recommendations, but he certainly understood the centrality of requirements determination to acquisition and to the length of the weapons cycle. Responding to Robertson's letter that had forwarded the Ad Hoc Study Group report, Wilson wrote: "(T)he problem of determining just what kind of a weapon should be designed and when it should be developed may also have a significant impact on the eventual time consumed. With the mounting cost of and complexity of weapon systems to consider, it becomes more and more urgent that we choose wisely among numerous systems at a relatively early stage in the development cycle." See ltr, C. E. Wilson, Secretary of Defense, to Reuben B. Robertson, Jr., Deputy Secretary of Defense, 21 February 1957, folder Aircraft, 1957, box 854, Subject Files (Research and Development, 1953–1960), OSD/HO.

136. See Volume II in the series, *History of Acquisition in the Department of Defense* (forthcoming).
137. *Summary of Actions Taken*, February 1957, 13; and a listing of actions taken by the Department of Defense that responded to the Preparedness Investigating Subcommittee's Recommendation No. 9 (Reduce lead time in the development of weapon systems by cutting down on decision time and by simplifying procurement procedures.), 4, atch to "The Seventeen Recommendations of the Preparedness Investigating Subcommittee, The Committee on Armed Services," n.d. (but on or about 3 April 1958), folder The Seventeen Recommendations of the Preparedness Investigating Subcommittee, box 39, Records, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO [hereafter Listing of Actions, Recommendation No. 9].
138. Summary of Action Taken on Recommendations of the Ad Hoc Study Group Report on Manned Aircraft Weapon Systems, encl. to ltr, Vice Adm. J. S. Russell, Chief, Bureau of Aeronautics, to Assistant Secretary of the Navy (Air) Garrison Norton, 8, 22 October 1956, sub: Robertson Committee Report; Submission of Initial Progress Report, box 10, BAH records, OAB, NHC; *Summary of Actions Taken*, February 1957, 12; Navy report of 26 March 1958; and Listing of Actions, Recommendation No. 9, 3-4. The first application of the project office concept in the Navy was the establishment of the Special Projects Office in late 1955 to manage acquisition of the Polaris missile system. See chap. 10 in this volume.
139. *Summary of Actions Taken*, February 1957, B–2. The program manager and project office concepts spread more slowly in the Army and were not institutionalized until 1962. See Lt. Gen. F. S. Besson, Jr., "Project Management within the Army Materiel Command," in *Science, Technology, and Management*, ed. Fremont E. Kast and James E. Rosenzweig, 104. See also chap. 11 in this volume in the series, *History of Acquisition in the Department of Defense*.
140. Ltr, Lewis L. Strauss to Deputy Secretary of Defense [Robert A. Lovett], 9 March 1951, atch to memo, Edward T. Dickinson, Assistant to the Joint Secretaries, Office of the Secretary of Defense, for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, 14 April 1951, sub: Report to the Deputy Secretary of Defense by Lewis L. Strauss, transmitted by letter of March 9, 1951, folder Joint Secretaries, April, box 132, entry 26 (Office of the Under Secretary of the Army, General Correspondence, Security Classified, Jan. 1951–Jan. 1953), RG 335; and ltr, Lewis L. Strauss to Secretary of Defense, 21 May 1952, atch to memo, Lt. Gen. Orval R. Cook, Deputy Chief of Staff, Materiel, Headquarters, U.S. Air Force, folder 160 A-Z, 1952, box 56, entry 377A (Office of the Deputy Chief of Staff, Materiel; Executive Office, Administrative Branch, General Decimal File, 1948–1952), RG 341.
141. House of Representatives Committee on Government Operations, 24th Intermediate Report, *Organization and Administration of the Military Research and Development Programs*, 83d Cong., 2d sess., 1954, H. Rpt. 2618 [hereafter Riehlman report]; and House of Representatives Committee on Government Operations, *Organization and Administration of the Military Research and Development Programs: Hearings before a Subcommittee of the Committee on Government Operations*, 83d Cong., 2d sess., 8–11, 14–18, and 22–24 June 1954 [hereafter Riehlman hearings]. The subcommittee heard the testimony of secretarial-level witnesses from the Department of Defense and current and former employees of Department of Defense research and development activities. But the committee drew most heavily on the testimony of about 50 nongovernment scientists and scientist administrators, 5 in person and the others by letter.
142. Commission on Organization of the Executive Branch of the Government, *Research and Development in the Government*, May 1955 [hereafter Hoover Commission Research and Development in the Government report]; Committee on Business Organization of the Department of Defense, *Business Organization of the Department of Defense*. Prepared for the Commission on Organization of the Executive Branch of the Government, June 1955 [hereafter Hoover Commission Committee on Business Organization report]; Task Force on Procurement of the Committee on Business Organization of the Department of Defense, *Report on Military Procurement*. Prepared for the Commission on Organization of the Executive Branch of the

Government, June 1955 [hereafter Hoover Commission Task Force on Military Procurement report]; Hoover Commission Subcommittee on Research Activities report; and Subcommittee on Special Personnel Problems of the Committee on Business Organization, *Report on Special Personnel Problems in the Department of Defense*. Prepared for the Commission on Organization of the Executive Branch of the Government, June 1955 [hereafter Hoover Commission Subcommittee on Special Personnel Problems report].

143. Ad Hoc Study Group report, 34-35, 38.

144. Special Subcommittee No. 6 of the House of Representatives Committee on Armed Services, *Hearings on Investigation of National Defense Establishment: Study of Procurement and Utilization of Scientists, Engineers, and Technical Skills*, 85th Cong., 2d sess., 14, 18, 20, and 31 March 1958 [hereafter Special Subcommittee No. 6 hearings]; and Subcommittee for Special Investigations of the House of Representatives Committee on Armed Services, *Study of the Armed Services Procurement Regulations and Departmental Implementation Thereto: Hearings before the Subcommittee for Special Investigations of the Committee on Armed Services, House of Representatives*, 85th Cong., 2d sess., 16–18 July 1958.

145. For a discussion of careers for officers in the services' support areas, see *An Action Report to the Assistant Secretary of Defense (Manpower, Personnel, and Reserve) Covering Hoover Commission Recommendations on Manpower and Personnel by a Department of Defense Working Group* [the Kushnik report, after the chairman of the working group, William H. Kushnik], 7 December 1955, 93, 95, 97, folder The Kushnik Report, box 23, entry 366C, RG 330 [hereafter Kushnik report].

146. Special Subcommittee No. 6 hearings, 29, 37. See also Riehlman report, 35; Hoover Commission Subcommittee on Research Activities report, 45, 86; Hoover Commission Research and Development in the Government report, 23; and Special Subcommittee No. 6 hearings, 100-01, 105, 153.

147. Hoover Commission Committee on Business Organization report, 61; Hoover Commission Subcommittee on Research Activities report, 44; Kushnik report, 115; and Vance O. Mitchell, *Air Force Officers Personnel Policy Development, 1944–1974*, 284-85, 297-98.

148. See Mitchell, *Air Force Officers*, 32-33, 78-79, 167-70.

149. Memo, Robert W. Koch, Special Assistant to the Secretary of Defense on Procurement Methods and Operations, for Deputy Secretary of Defense Roger M. Kyes, 26 October 1953, sub: Department of Defense Procurement Methods and Operations, folder DoD Procurement Methods and Operations, box 22, entry 189 (Records Accumulated by Robert W. Koch, Special Assistant to the Secretary of Defense, Relating to the Establishment of Effective Procurement Methods and Operations throughout the Department of Defense, Apr.–Oct. 1953), RG 330; Riehlman report, 35; Riehlman hearings, 417; Hoover Commission Task Force on Military Procurement report, 68; Hoover Commission Subcommittee on Research Activities report, 44; Hoover Commission Subcommittee on Special Personnel Problems report, 39-40; Kushnik report, 113, 115; Office of the Assistant Secretary of Defense for Manpower, Personnel, and Reserve, *Personnel Administration, Department of Defense based on Recommendations of the Commission on Organization of the Executive Branch of the Government*, January 1956, Category III (Officer Careers), 2, box 32, entry 366C, RG 330; and Ad Hoc Study Group report, 34-35.

150. Surveys and Investigations Staff, House of Representatives Committee on Appropriations, *A Report to the Committee on Appropriations, U.S. House of Representatives on Procurement Policies and Practices, Department of Defense*, January 1956, 44-45, box 2, entry 160A, RG 330 [hereafter Procurement Policies and Practices report]. See also Hoover Commission Task Force on Military Procurement report, 68.

151. Press Release No. 570-53, Office of Public Information, Department of Defense, address of Deputy Secretary of Defense Roger M. Kyes, to the Detroit Board of Commerce, Detroit, Michigan, 24 June 1953, 12, folder Kyes, 1953, box 17, Biographical Files (Deputy Secretaries, 1951–1956), OSD/HO; Hoover Commission Research in the Government report, 23-24; and Hoover Commission Subcommittee on Research Activities report, 45. Vice Adm. F. L.

Ashworth, recalling the troubled and long-lived Mark 48 torpedo program, assessed the impact of short officer tours on continuity and accountability: "It's awfully difficult to pin down any responsibility. For example, take the Mk 48 torpedo. . . . When I left the Bureau [of Ordnance], we were having problems with the engine and that hadn't quite settled down but I thought we had the seeker system; I thought we had the hydrodynamics solved, I thought we had all the technical problems licked except the possibility of the engine and we had two strings to the bow on that. Well as I understand it as the Mk 48 development went on, it became crystal clear that we didn't have these problems solved. Well, my successor could say, 'Don't look at me; it wasn't on my watch; the contracts were let by Ashworth.' And all I have to say is, 'Well gee whiz don't look at me; I thought it was all right when I left. We let two contracts for contract definition; how come you guys goofed it up.' In reality for a program like that there ought to be some continuity to it so that there is a degree of responsibility for this darn thing. And I think this sort of happens all the way along the line, and there is a big learning process. I think this tends to end up with a fairly high degree of management mediocrity, because we've got people learning all the time." Vice Adm. F. L. Ashworth, interview by A. B. Christman, 9 and 10 April 1969, Naval Weapons Center, China Lake, Calif., 76, box 868, Oral History Collection, Archives of the Navy Laboratory Center Coordinating Group, 1940s–1990s, OAB, NHC.

152. Riehlman report, 34.

153. Hoover Commission Subcommittee on Research Activities report, 44.

154. Procurement Policies and Practices report, 5-6.

155. Robert W. Koch, conducting a special study of procurement methods and operations for Deputy Secretary of Defense Kyes in 1953, reported: "I get the impression that Navy procurement officers have more prestige than those in the other Services. This is probably what prompted a senior Army officer to state he would prefer to resign rather than to take on another procurement position." See memo, Robert W. Koch, Special Assistant to the Secretary of Defense on Procurement Methods and Operations, for Deputy Secretary of Defense Roger M. Kyes, 26 October 1953, sub: Department of Defense Procurement Methods and Operations, folder DoD Procurement Methods and Operations, box 22, entry 189, RG 330. And yet, even one of the Navy's top acquisition posts, the director of naval research, did not seem to be highly valued. Of the six officers who had held the position since 1946, four retired before completing their terms. See House of Representatives Committee on Government Operations, 32d Report, *Research and Development (Office of the Secretary of Defense)*, 85th Cong., 2d sess., 1958, H. Rpt. 2552.

156. McKinsey & Company, *Evaluation of Organizational Responsibilities, Department of the Army*, Vol. II, 31 March 1955, 2: 22, folder McKinsey Report, box 16, entry 366C, RG 330.

157. Riehlman report, 35, 46 (quotation). In 1958, of the 378 general officers on active duty in the Air Force, more than half were serving in support activities. Yet of the total of general officers, only 41 were nonrated (officers not qualified to fly). For the number of general officers and the breakdown between rated officers (pilots and navigators) and nonrated officers, see the table (United States Air Force Line General Officers, 1939–1973), in Mitchell, *Air Force Officers*, 373. For the claim that half of the total of these general officers were serving in support positions, see Kushnik report, 99. The report specified 427 general officers as being on active duty in 1955. I have used the figures in Mitchell because the Kushnik report does not indicate how many of the 427 were nonrated.

158. Defense Advisory Committee on Professional and Technical Compensation [Cordiner Committee, after its chairman, Ralph J. Cordiner], *A Plan of Action to Attract and Retain Professional, Technical, and Managerial Employees for Defense: A Report and Recommendation to the Secretary of Defense*, Vol. II, *Civilian Personnel*, May 1957, 4, folder Cordiner Committee, 1957–1958, box 1056, Subject Files (Manpower, 1945–1960), OSD/HO [hereafter Cordiner Committee report].

159. According to the Hoover Commission, "The compensation level for the civil service scientists and engineers engaged in professional work for the three military departments is their

most acute personnel problem." See Hoover Commission Subcommittee on Research Activities report, 43.

160. Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1955*, 32.

161. Cordiner Committee report, 5-6. See also Riehlman report, 35-36, 46.

162. Cordiner Committee report, 7-8.

163. Hoover Commission Subcommittee on Research Activities report, 45.

164. Riehlman hearings, 417.

165. Dr. Wallace R. Brode, interview by A. B. Christman, May 1969, Naval Weapons Center, China Lake, Calif., 1, box 870, Oral History Collection, Archives of the Navy Laboratory Center Coordinating Group, 1940s–1990s, OAB, NHC.

166. Quoted in Ron Westrum, *Sidewinder: Creative Missile Development at China Lake*, 259.

167. Riehlman report, 39-41. See also Riehlman hearings, 201-99, 342-69.

168. Ltr, R. D. Sheeline, Reasons for Resigning from the Bureau of Ordnance, 22 August 1955, folder Military-Civilian Relationships in Top Policy and Administrative Offices, box 1, entry 632 (Assistant Secretary of Defense, Manpower and Reserve Affairs; Civilian Personnel Policy, 1951–1972), Accession 330-75-147, RG 330.

169. Sheeline's letter was forwarded to the deputy secretary of defense (who had also been a member of the Hoover Commission's subcommittee on Special Personnel Problems in the Department of Defense) by the deputy assistant secretary of the Army for logistics, most likely because Sheeline claimed that a "military-civilian partnership" existed in the Army's Ordnance Corps. See memo, Henry M. Marsh, Deputy Assistant Secretary of the Army (Logistics), for Deputy Secretary of Defense Reuben B. Robertson, Jr., 12 September 1955, ibid.

170. Hoover Commission Task Force on Military Procurement report, 68. The Office of the Assistant Secretary of Defense for Manpower, Personnel, and Reserve conceded that an "imbalance" existed between military officers and civilians in division chief positions in support fields except in research and development and civilian personnel management. See Action Program, Category V (Military and Civilian Career Managers in Support Activities), 2.

171. Ltr, Strauss to Secretary of Defense, 21 May 1952, 4-5; Riehlman report, 46, 48; Hoover Commission Research and Development in the Government report, 24-25; Hoover Commission Committee on Business Organization report, 61-70; Hoover Commission Task Force on Military Procurement report, 68-69; Hoover Commission Subcommittee on Research Activities report, 86-88; Hoover Commission Subcommittee on Special Personnel Problems report, passim, but especially 79-88; Ad Hoc Study Group report, 38-40; and Cordiner Committee report, 7-8.

172. Department of Defense Directive 4000.8 (Military Supply System Regulations), 5 September 1952, 9, folder Selected Directives, box 26, entry 189, RG 330.

173. Ltr, Donald A. Quarles, Assistant Secretary of Defense (Research and Development), to Chet Holifield, Chairman, Military Operations Subcommittee, Committee on Government Operations, House of Representatives, 3 March 1955, folder Research and Development (General), 1956–1959, box 832, Subject Files (Research and Development, 1953–1960), OSD/HO.

174. Department of Defense Directive 1315.5 (Rotation of Military Personnel in Managerial Positions in Support Activities), 24 March 1956, folder Progress Reports on DoD Reorganization, 1953–1956, box 27, Subject Files (Organization), OSD/HO.

175. Department of Defense Directive 1430.2 (Assignment of Responsibilities for Civilian Career Programs), 24 March 1956; and Department of Defense Instruction 1430.1 (Civilian Career Development), 28 September 1955: both ibid. According to Wilson's directive, civilian career programs were to include clear lines of advancement to progressively more responsible positions; procedures for appraising employee potential and training needs; a coordinated training and development program drawing on both internal and nonfederal resources (especially college and university management training courses) to improve present

job performance and to prepare employees for higher responsibilities; provision for a minimal annual intake into the occupational specialty of carefully selected personnel with potential to hold responsible management positions; and procedures for installation, command, or department-wide position vacancy referrals.

176. Memo, Reuben B. Robertson, Jr., Deputy Secretary of Defense, for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, Assistant Secretaries of Defense, 5 April 1956, sub: Inventory of Management Positions in Support-Type Activities in the Department of Defense, ibid.

177. Department of Defense Directive 1100.9 (Military-Civilian Staffing of Management Positions in Support Activities), 24 April 1957; and draft of ltr, Robert Dechert, General Counsel, Department of Defense, to Carl Vinson, Chairman, Committee on Armed Services, House of Representatives, atch to memo, Frank J. Sherlock, Director, Legislative Reference, Office of the General Counsel, Office of the Secretary of Defense, for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, Assistant Secretaries of Defense, 12 December 1957, sub: H. R. 8091, H. R. 8097, and H. R. 8100, 85th Congress, identical bills "To implement recommendations of the Commission on Organization of the Executive Branch of the Government with respect to improving management and technical personnel in the support activities of the Department of Defense, and for other purposes," folder Special Personnel Problems in the DoD (Hoover Commission Report), box 11, entry 366C, RG 330. Department of Defense Directive 1100.4 (Guidance for Manpower Programs), 20 August 1954 (copy in folder Military-Civilian Relationships in Top Policy and Administrative Offices, box 1, entry 632, RG 330), and Department of Defense Directive 1100.9 provided criteria for determining which positions should be filled by military officers and which by civilians. According to DoD Directive 1100.9, "Civilian personnel will be used in positions which do not require military incumbents for reasons of law, training, security, discipline, rotation, or combat readiness, which do not require a military background for successful performance of the duties involved, and which do not entail unusual hours not normally associated or compatible with civilian employment." The directive also stated that civilians should be assigned to management positions "when the specialist skills required are usually found in the civilian economy and continuity of management and experience is essential and can be better provided by civilians." Military personnel, according to DoD Directive 1100.9, were to be assigned to management positions when "required by law, when the position requires skills and knowledge acquired primarily through military training and experience, and *when experience in the position is essential to enable the officer personnel to assume responsibilities necessary to maintain combat-related support and proper career development*" [italics added]. The last mentioned criterion was the "career broadening" rationale that justified the assignment of officers with specialties in operations to management positions in support activities, including acquisition. This provision was potentially in conflict with other language in the directive requiring that military and civilian personnel assigned to such positions "must be qualified by training and experience."

178. Hoover Commission Committee on Business Organization report, 60.

179. Memo, O. M. Gale, Special Assistant to the Secretary of Defense, for Secretary of Defense McElroy, 19 May 1958, folder DoD Organization 1960 and Prior, box 51, Records, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO.

180. Suggested Statement for Inclusion in Secretary of Defense's Testimony before [Sen. Henry M.] Jackson Sub-Committee, 7 July 1961, and attached table (Status of Army-Wide Career Management Programs as of 30 June 1961), folder Civilian Career Development, box 3, entry 52 (Assistant Secretary of Defense, Manpower and Reserve Affairs; Civilian Personnel Policy Files, 1949–1968), RG 330.

181. Memo, Ray A. Crosby, Office of Industrial Relations, Department of the Navy, for Leon L. Wheeless, Office of the Assistant Secretary of Defense (Manpower and Reserve Affairs), 28 June 1961, sub: Statement Concerning the Department of the Navy's Career Planning Program, ibid.

182. Ltr, John E. Ehrmantraut, Acting Chief, Employee Programs Division, Directorate of Civilian Personnel, Headquarters, U.S. Air Force, to Director, Civilian Personnel Division, Office, Assistant Secretary of Defense (Manpower), 29 June 1961, sub: Career Development, ibid.
183. Recommendations of the Civilian Joint Study Group on the Civilian Procurement Program, atch to memo, Secretary of Defense Robert S. McNamara, for Secretary of the Army, Secretary of the Navy, Secretary of the Air Force, Assistant Secretary of Defense (Manpower), Assistant Secretary of Defense (Installations and Logistics), Director, Defense Supply Agency, 3 May 1965, sub: Career Development of Military and Civilian Procurement Personnel, unmarked folder, box 7, entry 618 (Assistant Secretary of Defense, Manpower, Personnel, and Reserve; Civilian Personnel Policy, 1949, 1967), RG 330.
184. *Summary of Actions Taken*, February 1957, 14, B-2.
185. Special Subcommittee No. 6 hearings, 153.
186. Peck and Scherer, *Weapons Acquisition Process*, 93-94; Blue Ribbon Defense Panel (Fitzhugh Commission, after its chairman, Gilbert W. Fitzhugh), *Report to the President and the Secretary of Defense on the Department of Defense*, 1 July 1970, 137-39; J. Ronald Fox with James L. Field, *The Defense Management Challenge: Weapons Acquisition*, 177-213; and Investigations Subcommittee of the House of Representatives Committee on Armed Services, *The Quality and Professionalism of the Acquisition Workforce*, 101st Cong., 2d sess., Committee Print No. 10 (8 May 1990), 30-47, 307-412.

I. Sources: Official biography of Donald A. Quarles (current as of May 1955), Press Branch, Office of Public Information, Department of Defense, folder Press Releases, box 30, entry 366C (Office of the Assistant Secretary of Defense [Comptroller]; Office of the Director for Plans and Systems; Hoover Commission Files), RG 330; "Donald A. Quarles," U.S. Air Force official website, Biographies Database, http://www.af.mil/information/bios/bio.asp?bioID=6830 (retrieved 25 July 2011); "Donald Aubrey Quarles," Arlington National Cemetery website, http://www.arlingtoncemetery.net/donaldau.htm (retrieved 25 July 2011); Glen R. Asner, "The Cold War and American Industrial Research," Ph.D. diss., Carnegie Mellon University, 2006, 179-80; George M. Watson, Jr., *Secretaries and Chiefs of Staff of the United States Air Force: Biographical Sketches and Portraits*, 29-30; George M. Watson, Jr., *The Office of the Secretary of the Air Force, 1947–1965*, 149-63; and Robert J. Watson, *Into the Missile Age, 1956–1960*, 128, 323, 475, 788.

II. Sources: Official biography of Frank D. Newbury (current as of March 1955), Press Branch, Office of Public Information, Department of Defense, folder Press Releases, box 30, entry 366C, RG 330; Glen R. Asner, "The Cold War and American Industrial Research," Ph.D. diss., Carnegie Mellon University, 2006, 125 (note 27), 152-53; Kevin Roy Cunningham, "Scientific Advisers and American Defense Policy: The Case of the Defense Science Board," Ph.D. diss., Stanford University, 1991, 110-18; and Bruce L. R. Smith, *The Advisers: Scientists in the Policy Process*, 52-53.

III. Sources: App. G (Historical Development of the Procurement Process), in U.S. Commission on Government Procurement, *Report*, 173-74; "The Hoover Commission Recommendations—15 February 1949," and "The Second Hoover Commission—1953–1958," in *The Department of Defense: Documents on Establishment and Organization, 1944–1978*, ed. Alice C. Cole, Alfred Goldberg, Samuel A. Tucker, and Rudolph Winnacker, 75-77, 164-71; Kevin Roy Cunningham, "Scientific Advisers and American Defense Policy: The Case of the Defense Science Board," Ph.D. diss., Stanford University, 1991, 93-95; Robert J. Watson, *Into the Missile Age, 1956–1960*, 27, 29; and Richard M. Leighton, *Strategy, Money, and the New Look, 1953–1956*, 35, 58-64.

IV. Sources: Biographical profile included in transcription of Clifford C. Furnas, "Research and Development in the Armed Forces," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 20 December 1957, ii, copy in NDU Library; and Glen R. Asner, "The Cold War and American Industrial Research," Ph.D. diss., Carnegie Mellon University, 2006, 190-207.

V. Sources: Item 1 (Introductory Remarks by C. C. Furnas), Minutes of the First Meeting of the Defense Science Board, 20 September 1956, 3 (quotation), box 834, Subject Files (Research and Development, 1953–1960), OSD/HO; Department of Defense Instruction 5128.31 (Defense Science Board Charter), 31 December 1956, file DoD Directives/Instructions, 1953–1960, OSD/HO; Kevin Roy Cunningham, "Scientific Advisers and American Defense Policy: The Case of the Defense Science Board," Ph. D. diss., Stanford University, 1991, passim, but especially chap. 2; Bruce L. R. Smith, *The Advisers: Scientists in the Policy Process*, 48-67; Robert J. Watson, *Into the Missile Age, 1956-1960*, 27, 135, 181-2, 362; and the Defense Science Board website, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics: http://www.acq.osd.mil/dsb/ (retrieved 7 September 2011).

VI. Sources: Defense Acquisition Workforce Improvement Act, 10 U.S.C., chap. 87, sec. 1721b; Merton J. Peck and Frederic M. Scherer, *The Weapons Acquisition Process: An Economic Analysis*, 85-86; Subcommittee on Research Activities in the Department of Defense and Defense Related Agencies of the Committee on Business Organization of the Department of Defense, *Report on Research Activities in the Department of Defense and Defense Related Agencies*. Prepared for the Commission on Organization of the Executive Branch of the Government, April 1955, 43; *Naval Weapons Bulletin*, no. 1-60 (January–March 1960), 4, folder Air Systems Command Series: *Naval Weapons Bulletin*, January–December 1960, box 1078, Post 1 Jan 1946 Command File, OAB, NHC; and table 4 (Department of Defense Manpower, FY 1940–2005), in *Department of Defense Key Officials, 1947–2004*, 90.

CHAPTER IX

Ascendancy of the Weapon System Concept: The Air Force and Acquisition, 1953–1960

On 9 September 1959, General Thomas S. Power, commander of the Strategic Air Command, announced that the Atlas D intercontinental ballistic missile had achieved operational status at Vandenberg Air Force Base in California. The event was largely symbolic—only one missile at the site went on alert, and it was maintained by a crew of civilian contractors. Still, the occasion was significant because it marked the first deployment of a U.S. intercontinental ballistic missile. Moreover, the emergency capability it represented had been achieved within two months of the schedule established four years earlier.[1]

The Atlas program's success demonstrated to many the efficacy of the Air Force's "weapon system" approach to acquiring large, complex, technologically advanced weapon systems. Since 1949, when planning began for the interceptor that ultimately became the F–102, the Air Force had gradually evolved the management methods associated with the weapon system concept. Its main features were designing a system, including its subsystems, as an integrated whole; developing subsystems and carrying out the development and production phases of the acquisition cycle concurrently; managing system acquisition centrally through a "project" organizational structure that drew specialists from a variety of functional areas; and, finally, assigning industry the primary responsibility for development and production. By 1960, the principles and procedures associated with the weapon system philosophy, particularly as applied in the Atlas, Titan, and Thor ballistic missile programs, were considered to be so successful that the Air Force institutionalized them in a set of regulations.

This chapter traces the weapon system concept's evolution during the 1950s. After a brief overview of the Air Force during this period, the chapter will survey the changes in acquisition organization and processes that the service implemented to accommodate the weapon system approach. It will then describe the concept's application in two major programs: the B–58 Hustler, the world's first supersonic strategic bomber; and the ballistic missile effort that produced the Atlas D.

Atlas D launch, Vandenberg Air Force Base, California, 9 September 1959.
Courtesy, History Office, Space and Missile Systems Center, Air Force Space Command.

THE AIR FORCE IN THE 1950s

The character of the Air Force changed dramatically during the Eisenhower years. At the end of the Korean War, the service was still limited to flying airplanes in the atmosphere. It did not yet possess an operational missile of any kind, although several were under development. In 1954, the Air Force deployed its first operational guided missile, the Matador, a nuclear weapons–equipped surface-to-surface, turbojet powered system built by the Martin Company. The next year, Falcon, a radar-guided, rocket-powered, air-to-air missile entered operational service.[2] By the end of the 1950s, the Air Force had become an aircraft and missile force, operating in both air and space. Atlas ICBMs and Thor intermediate range ballistic missiles took their place alongside SAC bombers as elements of the nation's strategic deterrent, and the service was working on both manned and unmanned systems that would ride missiles into space. The three most important factors behind the Air Force's transformation during this period were actual and anticipated Soviet military capabilities, a national security policy and strategy that relied principally on nuclear weapons, and the relentless advance of weapons technology.

During the 1950s, the Eisenhower administration's political opponents charged that the United States had fallen behind the Soviet Union in both bombers and missiles. The alleged bomber and missile gaps proved to be exaggerated; nonetheless, the Soviets had demonstrated formidable strategic military capabilities by 1960.[3] In August 1953, they detonated a thermonuclear (hydrogen) bomb. In 1954 and 1955, they deployed new bombers apparently possessing range sufficient to reach the United States. In the summer of 1957, they test-launched the world's first ICBM that would place the first two artificial satellites into earth orbit in the fall. Finally, in May 1960, the Soviets also showed the prowess of their defensive systems when one of their surface-to-air missiles shot down a high-flying U–2 reconnaissance aircraft operated by the Central Intelligence Agency.

To counter the dangers posed by Soviet military capabilities, the economy-conscious Eisenhower administration decided to depend on the threat of massive retaliation with nuclear weapons. This security policy and strategy, known as the New Look, solidified the Air Force's position, already apparent during the Truman administration, as the nation's first line of defense. Throughout the 1950s, Strategic Air Command bombers were the mainstay of a strategic deterrent that at the end of the decade numbered more than 1,700 intermediate-range B–47s, long-range B–52s, and intermediate-range B–58s, all able to carry nuclear weapons. Beginning in 1959, strategic missiles became part of SAC's order of battle, first Thor IRBMs and then Atlas ICBMs. As a result of its central strategic role, the Air Force received the largest share of the Defense Department budget, averaging more than 44 percent annually from FY 1955 through FY 1961. Also, the Air Force was not hit as hard by spending cuts as were the other services, especially the Army and Marine Corps with their relatively high-cost conventional ground forces (see chap. 8).

AIR FORCE ACTIVE FORCES
FY 1954–FY 1961

FY	1954	1955	1956	1957	1958	1959	1960	1961
Wings	115 ⅓	121	131	137	103	105	96	88
Personnel [1]	948	960	910	920	871	840	815	821

1. Personnel figures (in thousands).

The Eisenhower administration drew much of its faith in the deterrent power of nuclear weapons from a parallel conviction that the United States would be able to maintain superiority in the advanced technologies that made the New Look strategy possible. That confidence was not misplaced. Weapons technology leapt ahead dramatically during the 1950s. With respect to the development of Air Force systems, the most significant advances involved nuclear warheads, aircraft and missile propulsion, and electronics.

Early in the decade, dramatic changes took place in the destructive power and physical characteristics of nuclear weapons. The advent of the hydrogen bomb meant that the same level of damage could be produced by fewer delivery systems—the first thermonuclear device was 1,000 times more powerful than the atomic bomb exploded over Hiroshima. The extent of the H-bomb's devastation also allowed accuracy requirements to be reduced, thus removing a major objection to employing long-range missiles. The standard for the Atlas, for example, was relaxed from a CEP (circular error probable) of one-fourth nautical mile (about 1,500 feet) to five nautical miles before the end of 1954. (The CEP denotes the length of the radius inscribing a circle within which one-half of the weapons targeted for the center of the circle will likely impact.)[4]

A reduction in nuclear warhead sizes and weights also had far-reaching effects on weapon system development. In late 1951, the Air Force equipped a tactical aircraft, the single-seat F–84G fighter-bomber, with a nuclear weapon.[5] Testifying before Congress early in 1954, General Nathan F. Twining, the Air Force chief of staff, stated that the service's objective was to ensure that all of its tactical fighters and bombers could carry nuclear weapons.[6] Arming tactical aircraft with nuclear weapons did much to redress the imbalance between NATO and Soviet ground forces in Europe. On the other hand, the high priority given to such systems caused conventional capabilities to be neglected. In 1955, responding to requests from two of his senior commanders for development of a light-weight jet fighter that could be used on conventional battlefields such as in Indochina, Twining replied that "under the limited dollar and force structure, our concept must insist that tactical air power be dedicated to delivery capabilities optimized for nuclear weapons."[7]

The arrival of smaller and lighter nuclear warheads had even greater consequences for missiles. In the Atlas D, such warheads permitted the substitution of a 3-engine configuration weighing 240,000 pounds for the original 5-engine, 450,000 pound design.[8] The new warheads also enormously increased the destructive power of missiles functioning in other roles and enhanced the capabilities of systems with missiles as components. Beginning in 1960, for example, B–52s began to carry the Hound Dog, a nuclear warhead–capable, turbojet-powered, air-to-surface missile with an inertial guidance system and a "standoff" range of 200-500 nautical miles that allowed the aircraft to attack heavily defended targets with less risk to itself.[9]

B–52F Stratofortress with Hound Dog air-to-surface missiles loaded on the inboard wing pylons. Courtesy, National Museum of the U.S. Air Force.

As with warhead technologies, advances in jet and rocket propulsion significantly increased Air Force capabilities. Nearly all of the Air Force's combat wings were equipped with jet aircraft by mid-1957.[10] Improved jet engines enabled aircraft to carry heavier payloads higher and faster than ever before.[11] Convair's B–58 Hustler, the intermediate-range strategic bomber that began to replace the subsonic B–47 in 1960, could operate above 60,000 feet at 1,147 knots (1,320 mph), nearly twice the speed of sound (760 mph at sea level, or Mach 1).[12] All of the famous "Century Series" fighters deployed by the Air Force during the 1950s—the North American F–100 Super Sabre, the McDonnell F–101 Voodoo, the Convair F–102 Delta Dagger, the Lockheed F–104 Starfighter, the Republic F–105 Thunderchief, and the Convair F–106 Delta Dart—were supersonic. Both the F–104 and the F–105 could exceed Mach 2—twice the speed of sound.[13] Performance specifications called for two new systems scheduled to become operational in the early 1960s, North American's XF–108 Rapier long-range interceptor, as well as the company's XB–70 Valkyrie strategic bomber (programmed to replace the B–52), to fly at Mach 3 and above 70,000 feet.[14]

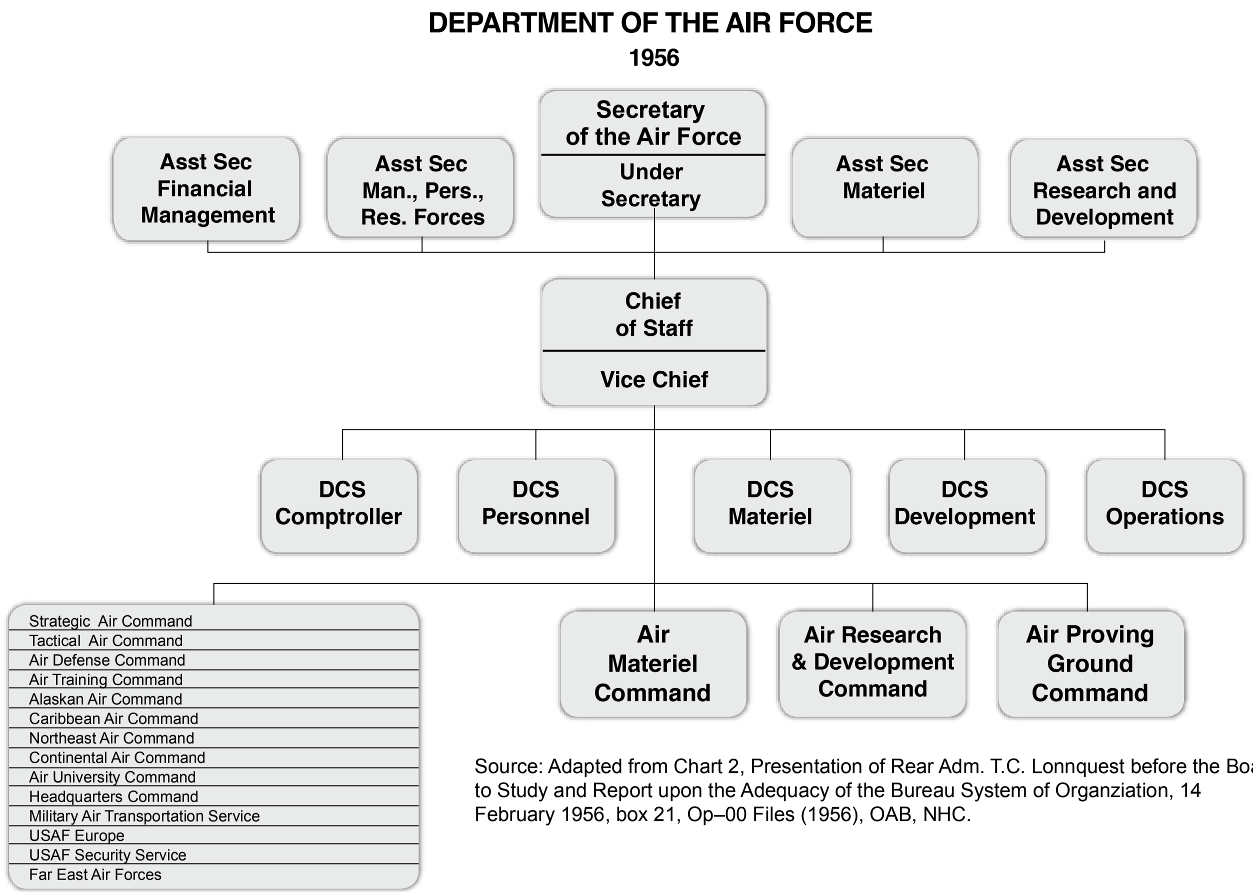
Four of the "Century Series" fighters deployed by the Air Force during the 1950s (counter clockwise from top): F–101 Voodoo, F–102 Delta Dagger, F–100 Super Sabre, and F–104 Starfighter.
Courtesy, National Museum of the U.S. Air Force.

By the end of the 1950s, rocket engines that generated hundreds of thousands of pounds of thrust made possible a strategic missile force that could deliver nuclear warheads from continent to continent and transport the Air Force into a new environment, outer space.[15] Before the end of the Eisenhower administration, engines developed for the Atlas and Thor ballistic missiles placed some of the first U.S. satellites in orbit. In addition to launching communications, navigation, and reconnaissance satellites, such engines were also central to Air Force plans for the Dyna-Soar (Dynamic Soarer), a manned, delta-shaped spacecraft and potential orbital bomber that, after being rocketed into space, would reenter the earth's atmosphere and glide to a landing.[16]

Along with advances in warhead and propulsion technologies, progress in electronics profoundly affected Air Force weapon system development. Aircraft systems, mostly mechanically driven in World War II, were largely electrically controlled by the 1950s. The wartime B–17 bomber had carried 1,600 pounds of electrical gear, including 105 vacuum tubes, but the postwar B–47 required 5,400 pounds of electronic systems and more than 10 times the number of vacuum tubes.[17] Such avionic subsystems and components grew increasingly expensive, accounting for as much as one-half the total cost of an aircraft by the mid-1950s.[18] Additionally, electronic technologies were changing so fast that they complicated system development decisions. In 1955, the Air Materiel Command's director of procurement and production engineering remarked to an Industrial College of the Armed Forces audience: "We don't have an electronics item coming off the production line before we have something so much better that we are ready to stop production and go into the other item."[19]

During the 1950s, the substitution of the transistor for the vacuum tube was arguably the most significant development in the application of electronic technologies to military systems. Transistors were far superior to their predecessors. For one thing, they lasted much longer. The life expectancy of early transistors was 70,000 hours, compared to the 1,000 or fewer hours normally obtained from vacuum tubes. Also, compared to vacuum tubes, transistors could absorb much more shock and vibration, generated very little heat, and did not require much power to operate.[20] But the transistor's chief importance was its small size. "Miniaturization," writes one of the leading historians of technology and warfare, "enabled smaller and smaller weapons to be equipped with their own electronic brains; more and more sensing and computing power was being built into the same amount of space."[21] More than any other single factor, the transistor (and the integrated circuit after 1960) was responsible for making the missile both an effective and a highly versatile weapon.

Whether aircraft or missile, air or space system, the complexities, scale, and cost of these technologies, combined with the perception that they must be fielded rapidly, shaped the Air Force's acquisition strategy, organizational structures, and processes in the 1950s. Taken together they became known as the weapon system, or simply, systems approach.



Source: Adapted from Chart 2, Presentation of Rear Adm. T.C. Lonnquest before the Board to Study and Report upon the Adequacy of the Bureau System of Organziation, 14 February 1956, box 21, Op–00 Files (1956), OAB, NHC.

ORGANIZATION FOR ACQUISITION

The idea that a system constituted an integrated whole, with its elements closely related to and interacting with each other, and that its acquisition should be planned and carried out accordingly was at the core of the weapon system approach. In 1950, despite the unity implied in the concept, the Air Force, in order to give greater emphasis and independence to research and development, divided responsibility for system acquisition from top to bottom throughout its organizational structure—between the deputy chief of staff for development and the deputy chief of staff for materiel on the Air Staff, between the Air Research and Development Command and the Air Materiel Command in the field, and between representatives of those two commands who worked together in the weapon system project offices (formerly joint project offices), which actually managed each system's development and production.[22] Since much of the weapons acquisition process was, in fact, indivisible, the separation did not work well. By the late 1950s, in large part based on the experience of the ballistic missile program, whose director enjoyed nearly complete and undivided authority over research, development, testing, and production, strong pressures emerged to assign responsibility for acquiring Air Force systems to a single organization. Institutional resistance proved too strong, however, and the effort failed.

The Problem of Divided Responsibility

In mid-1953, the secretary of the Air Force and the chief of staff both expressed doubt that the division of responsibility for acquisition that resulted from the creation of the Air Research and Development Command in 1950 had been a good idea. Secretary of the Air Force Harold Talbott indicated that from an organizational viewpoint, the establishment of an independent command for research and development had created a "mess" that had to be cleaned up.[23] General Twining, who had commanded the Air Materiel Command shortly after World War II, told the Army's assistant chief of staff for logistics (G–4) that "all of the trouble the Air Force is having arises from its having completely separated research and development from procurement and production."[24] The "mess" and "trouble" that Talbott and Twining were referring to and that they attributed to the service's divided acquisition structure was the Air Force's poor development and production record during the Truman administration's military buildup. Although billions of dollars had been appropriated, new systems encountered major delays, lagged well behind delivery schedules, suffered significant performance shortfalls, and experienced substantial cost overruns (see chaps. 3, 5, and 6).

Air Force leaders considered several proposals to unify responsibility for managing acquisition: (1) create a second vice chief of staff (for logistics) located organizationally above the deputy chief of staff for development and the deputy chief of staff for materiel, (2) subordinate the position of deputy chief of staff for development to that of the deputy chief of staff for materiel, (3) establish an intermediate headquarters between the Air Staff and the two field commands, the Air

Research and Development Command and the Air Materiel Command, to which the field commands would report, or (4) combine the Air Research and Development Command and the Air Materiel Command into one organization. Talbott initially leaned toward setting up an intermediate headquarters, but eventually decided to retain the two field commands and make the deputy chief of staff for materiel the organizational superior of the deputy chief of staff for development. This realignment tied R&D and procurement together at Air Force headquarters, provided a high-level focal point for service acquisition decisions that many in industry desired, and avoided a major organizational restructuring.[25] The new arrangement, however, did not last long. Early in 1955, Secretary Talbott elevated the position of special assistant for research and development to assistant secretary, and thus organizationally equivalent with the other assistant secretaries, including the assistant secretary for materiel.[26] Soon thereafter, General Twining reestablished the deputy chief of staff for development as a separate position on the Air Staff, coequal with the deputy chief of staff for materiel.[27]

In the field, the dual field-command acquisition structure caused problems throughout the 1950s. In an interview after his retirement, General Bernard Schriever, who became head of the Air Research and Development Command in 1959, recalled the state of the relationship with the Air Materiel Command: "The two commands never got along. They were constantly bickering and fighting. Every decision between the two . . . would have to go to the Air Staff for resolution. It was an unsatisfactory arrangement and a lot of people knew it."[28]

The major friction point was the lack of a clear-cut division of responsibility between the two field commands for managing the acquisition of new systems. In 1954, the Air Force sought to clarify their management roles. A new regulation prescribed that "executive management responsibility" would shift from the Air Research and Development Command to the Air Materiel Command when the Air Staff decided a system should be produced in quantity for the operational inventory.[29] The regulation thus extended the arrangement that had governed the transfer in "team captaincy" in the weapon system project offices since the fall of 1952 to all levels of both commands. This functional division, however, did not end the rivalry because the Air Force employed a high degree of concurrency in most of its major systems in the 1950s.[30] In this acquisition strategy, development continued throughout production and often into deployment, which made clarification of command responsibilities especially difficult.

Other major sources of organizational conflict were that the deputy chief of staff for materiel and the Air Materiel Command controlled the resources that the Air Research and Development Command needed to do its job; they also possessed authority over Air Force contracting. As much as 80 percent of the money for research and development came from procurement, construction, and personnel appropriations accounts that were administered by the deputy chief of staff for materiel and the Air Materiel Command. For the Air Research and Development Command to obligate or spend these funds required their approval. Furthermore, because they controlled most R&D funds, the deputy chief of staff for materiel and the Air Materiel Command were able to influence preparation of the R&D budget. In addition to its funding and budget leverage, the Air Materiel Command held a vise-like grip over contracting. The secretary of the Air Force had designated AMC the service's sole procurement agency. This authority enabled it to determine contracting procedures, terms, and conditions, and to set the value of contracts that the Air Research and Development Command could let without its approval. Until the late 1950s, the maximum value of contracts that ARDC was permitted to conclude on its own was $250,000.[31]

The Weapon System Project Office

The fissure in the Air Force's acquisition structure also appeared in the weapon system project office, or WSPO, the organizational entity most directly involved in acquiring new systems. Composed of representatives from the Air Research and Development Command and the Air Materiel Command, the weapon system project offices managed weapon system programs at field level to ensure their timely delivery and adequate support. In these respects, their responsibilities encompassed actions pertaining to system development, testing, production, maintenance, and supply. They also served as the focal point during the acquisition process for both industry and other Air Force agencies, such as the Air Staff and the training and using commands. Under the "team captaincy" rubric, an officer from the Air Research and Development Command served as chief of the project office until the Air Staff decided to produce the system in quantity; at that point, an Air Materiel Command officer took over project direction. As a rule, a project office was usually established when Air Force headquarters issued a development directive for a weapon system, and was disbanded when the system entered the active inventory. The weapon system project office reflected the attempt to fashion an organizational unit compatible with the Air Force's functional and divided acquisition structure, and with the integrated nature of weapon system development and production that cut horizontally across that framework.[32]

By late 1956, 62 weapon system project offices were in operation.[33] With the exception of the West Coast ballistic missile operation, all were located at Wright-Patterson Air Force Base in Ohio, which was the home of the Air Materiel Command and the Wright Air Development Center, the Air Research and Development Command's major subordinate organization. Depending on the importance of the particular system, each project office numbered from 2 to as many as 50 military and civilian personnel drawn from both ARDC and AMC but not from the training and using commands.[34] One outside observer described the project offices as "almost as noisy and confusing as a newspaper office just before the edition goes to press."[35]

Aside from the project chief and the deputy chief, weapon system project office personnel were largely specialists drawn from functional elements of their respective commands. The Air Research and Development Command representatives possessed expertise in aerodynamics, electronics, propulsion, flight test, navigation, ground support equipment, and training; the Air Materiel Command members specialized in budgeting, contracting, production, maintenance, and supply.[36]

Normally, project office chiefs were lieutenant colonels.[37] In contrast to most project office personnel, technical expertise was not necessarily the most important criterion in their selection. In late 1953, the chief of staff of the Wright Air Development Center wrote the deputy chief of staff for personnel at Air Research and Development Command headquarters that in choosing project officers, the center was "looking primarily for a pilot who is a good manager and secondarily for a Research and Development officer."[38] A 1956 staff paper prepared for the Robertson committee's study of aircraft acquisition cycle time provided statistics on the qualifications of Air Force project officers. The study noted that 43 percent of ARDC project officers and only 2 percent of their AMC counterparts held an advanced engineering degree. Project officers from both commands lacked business or industrial training—none of the ARDC officers and only 18 percent of the AMC officers possessed such experience.[39]

In addition to deficiencies in qualifications, most project officers were on the job for relatively brief periods—especially when measured against the average of eight years that it took to bring an aircraft from concept to inventory in the mid-1950s (see chap. 8). Although the standard tour length was supposed to be a minimum of three years for ARDC project officers and four years for those in AMC, actual average tour lengths were much shorter—26 months for the former and 22 months for the latter. Moreover, there was little or no overlap when a new project officer from either ARDC or AMC succeeded his predecessor.[40]

Compared with their wide-ranging responsibilities, weapon system project offices had limited authority. In the first place, they lacked complete control over system development. For example, they did not select some major subsystems, such as propulsion, and had to forward proposals for significant design changes, particularly those involving system capability, to the Air Staff for approval. Since the project offices were located several organizational levels below the Air Staff, securing approval could be a lengthy process. The project offices also had little say when it came to the system's budget or funding. In these areas, their role was to collect cost data from the contractor and forward budget recommendations to higher headquarters. Decisions about program budgets and funding were made above the project office, ultimately at Air Force headquarters.[41]

Such limited authority made the weapon system project office primarily a coordinator. To carry out this function, the project office operated through the Weapon System Phasing Group, a committee usually chaired by the chief of the project office. It was made up of Air Research and Development Command and Air Materiel Command personnel along with representatives from the Air Staff and the training and using commands. Contractors also attended the group's meetings, but were not official members. The Weapon System Phasing Group reviewed the program's status periodically and addressed problems encountered during development and production. The chairman assigned corrective action to the appropriate functional agency through its representative on the group who provided status reports on measures taken to resolve the difficulty. If the chief of the weapon system project office was dissatisfied with the results, he had to seek redress through his own chain of command, not directly with the responsible functional agency.[42]

A Single Command for Acquisition

Despite much dissatisfaction with the service's split acquisition structure, General Thomas D. White, who succeeded Twining as chief of staff when the latter became chairman of the Joint Chiefs of Staff in the summer of 1957, did not wish to consider changes in the organization or functions of the Air Research and Development Command and the Air Materiel Command. In the last week of September, he informed General Curtis LeMay, the vice chief of staff, that "This matter is not to be reopened. We will thus insure some organizational stability in these two areas for the next few years."[43]

But just 10 days after White's instruction to LeMay, the Soviets placed Sputnik in orbit and the United States began reexamining its organization and procedures for acquiring advanced weapons technologies. The resulting Department of Defense Reorganization Act of 1958 gave the secretary of defense control over new technology development in the services by establishing the position of director of defense research and engineering. Secretary of Defense Neil McElroy had already begun to expand the role of the Office of the Secretary of Defense in research and development when he created the Advanced Research Projects Agency earlier in the year. In the Air Force, Lt. Gen. Samuel E. Anderson, head of the Air Research and Development Command, requested—and General White approved—a comprehensive review of the service's research and development program to be conducted by the Scientific Advisory Board. In June 1958, an ad hoc committee appointed by the board to perform the study issued its report. Among the committee's numerous recommendations were to give both the Air Research and Development Command and the individual weapon system project offices more authority for carrying out their activities.[44]

In early 1959, the Air Force's top leadership decided that the service's management process for new systems needed a thorough going over in view of the radical changes that had taken place in the acquisition environment since adoption of the weapon system approach early in the decade. Among these changes were new, complex, and costly families of systems in the electronics, ballistic missile, and space fields. In May, General LeMay formed the Weapon System Management Study Group to review Air Force policies and procedures for managing weapon systems throughout their life cycles. LeMay had not included reorganization as part of the group's charter, but neither had he excluded it. Chaired by Lieutenant General Anderson, who had moved laterally from the Air Research and Development Command to head the Air Materiel Command, the group's other members were Lieutenant General Schriever, the newly appointed ARDC commander, and several general officers from the Air Staff, including the deputy chiefs of staff for development, materiel, and operations along with the comptroller and the inspector general. A working group comprised largely of colonels supported the study group's activities.[45]

The sharp contrast between the apparently spectacular success of the Air Force's ballistic missile programs and the relatively less lustrous records of the service's other missile and aircraft programs formed an important part of the background to the Weapon System Management Study Group's deliberations. Systems developed and fielded under the divided organizational structure and process had required lengthy acquisition cycles. The B–52 program, for example, began in 1946, but the aircraft did not enter operational service until 1955.[46] Development of the subsonic, jet-powered Snark intercontinental missile also started in 1946, but a production model was not flight-tested until April 1959, just as the Weapon System Management Study Group was about to begin its work.[47] On the other hand, the ballistic missile program, which was only loosely tied to existing organizational arrangements and allowed to depart from standard operating procedures, was fielding highly complex systems much more rapidly. By the spring of 1959, Thor IRBMs were on alert at bases in Great Britain, only 3½ years after the Air Staff had issued a requirement for the system. And, as previously noted, the Atlas D intercontinental ballistic missile would attain an emergency operational capability in September 1959, just two months later than the target date established in 1955.[48] In chartering the Weapon System Management Study Group, General LeMay asked that it consider whether aspects of the ballistic missile program model, particularly its emphasis on concurrent development of all system elements, should be applied Air Force-wide.[49]

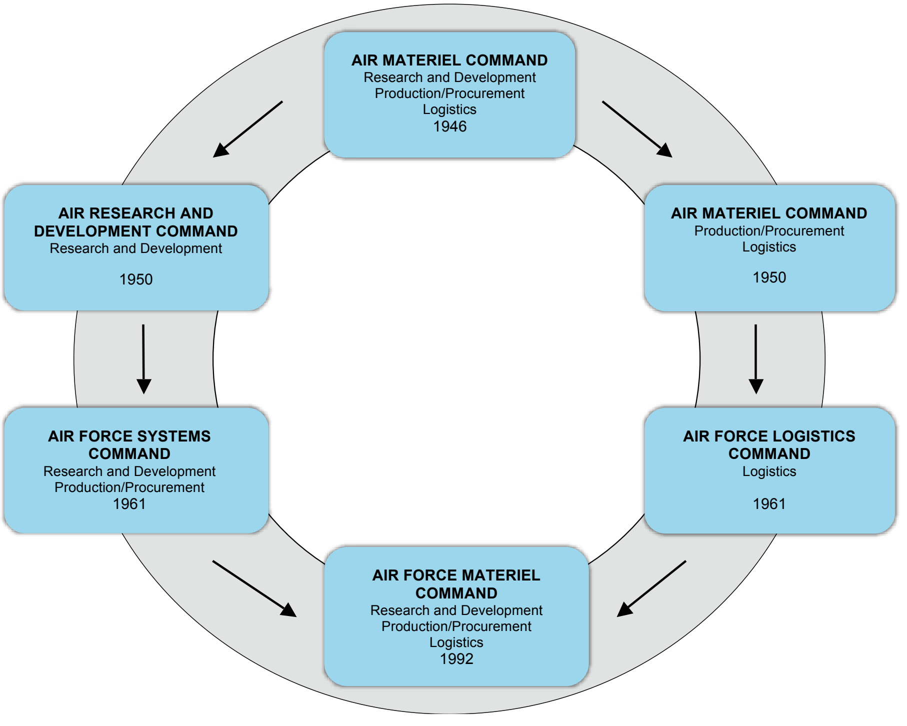
In the fall of 1959, the colonels' working group reported its findings to the general officer study group. Its key conclusion was that development and production should be combined into one command. Agreeing in principle to this fundamental concept, the study group directed the working group to come up with an implementation plan.[50]

Early in 1960, the working group presented its proposal. The colonels recommended the immediate creation of an "Aerospace Weapons Command" with responsibility for research, development, procurement, and production. Logistics functions such as supply and maintenance would be performed by the Air Materiel Command. In 10 years, according to the plan, the two commands would be combined to form one acquisition agency similar to the pre-1950 Air Materiel Command.[51] After his retirement, Lt. Gen. Otto J. Glasser, one of the colonels on the working group in 1959–1960, remembered the reaction when he briefed the plan to the general officer study group: "Oh man did I get chewed up. General Anderson was absolutely livid."[52] Anderson, who commanded the Air Research and Development Command prior to Schriever, favored consolidating functions but, perhaps reflecting the proposition that "where one stands depends on where one sits," did not intend for the realignment to come at the expense of his own organization, the Air Materiel Command.[53]

Through the end of May 1960, the Weapon System Management Study Group was unable to agree on a course of action. To resolve the impasse, it requested General White, the chief of staff, to select one of three options: (1) transfer procurement and production from the Air Materiel Command to the Air Research and Development Command as recommended by the colonels' working group, (2) combine the two commands into what amounted to a reconstitution of the pre-1950 Air Materiel Command, or (3) retain the dual command setup and existing division of acquisition responsibilities, but seek wider application of aspects of the management system practiced in the ballistic missile program. White, concluding that the time was not right for a sweeping reorganization and functional realignment, chose the last alternative.[54]

Within a year of the decision to retain the organizational status quo, an opportunity offered by the newly installed Kennedy administration for the Air Force to take control of the military space mission in the Department of Defense caused a fundamental restructuring of the service's acquisition structure. In a reorganization announced in March 1961 that generally followed the recommendation made by the colonels' working group the previous year, the Air Force dissolved the Air Research and Development Command and the Air Materiel Command, creating two new commands in their place. The Air Force Systems Command would be responsible for applied research, development, testing, production, and delivery of operable systems to the using commands, while the Air Force Logistics Command would carry out supply and maintenance functions for those systems. To alleviate long-held fears, especially in the scientific community that research would take a back seat in an organization that was also responsible for production, the Air Force established the Office of Aerospace Research, which would report directly to the Air Staff. [55] More than three decades later, in 1992, in a realization of the working group's long-term vision for organizational unity in acquisition, the Air Force disbanded both the Systems Command and the Logistics Command, replacing them with the Air Force Materiel Command.

FULL CIRCLE: AIR FORCE ACQUISITION FIELD COMMAND STRUCTURE



THE WEAPON SYSTEM CONCEPT AND THE ACQUISITION PROCESS

Along with stimulating the introduction of a new organizational form during the 1950s, the weapon system project office, implementation of the weapon system philosophy also revolutionized the Air Force's acquisition process. In acquiring new systems, the Air Force came to prefer concurrency to the traditional sequential strategy, and industry assumed an unprecedented role in managing development and production. The complexity of modern weapons and the need to deploy them rapidly in the face of the escalating arms race were the driving forces behind this transformation. Those factors were also responsible for other significant changes in the acquisition process involving contractor selection, testing, and production policy that, although not integral features of the weapon system approach, were linked to it.

By 1960, concurrency, the weapon system concept's most recognizable feature, had been institutionalized in Air Force acquisition regulations. The term originated in the service's ballistic missile program in 1955 as a shorthand way of conveying complex activities to outside observers in presumably more easily understood terms, but it was not used in the missile organization, by its contractors, or in the Air Force generally at that time.[56] Fundamentally, concurrency meant simultaneity. In this sense, and although not referred to by that name, concurrency had been a part of Air Force acquisition since the beginning of World War II. It involved initiating production before development, particularly testing, was completed as a way of speeding the deployment of new systems. Following the war, the B–36 and B–47 strategic bombers and numerous fighters, including models of the F–84, F–86, F–100, and F–101, were all examples of such programs. But none of these systems was designed from the outset to include all of their elements as part of an integrated whole.

Concurrency as applied in programs managed according to the weapon system concept—partially with the F–102, more extensively with the B–58, but most completely with the Atlas, Titan, and Thor ballistic missiles—was a much broader notion. According to Maj. Gen. Osmond J. Ritland, who succeeded General Schriever as head of the Air Force's ballistic missile program in 1959, concurrency meant:

> . . . everybody moving forward with everything all at once. Under the concept each element of the total weapon system is integrated into a single plan, program, and budget, and all are implemented concurrently, in unison, consistent with lead-time requirements. Simply speaking, concurrency implies progress in parallel fashion rather than in series fashion.[57]

In other words, work on subsystem development, production activities, and aspects of system deployment, such as operator training and facilities construction, went forward simultaneously as part of a coordinated plan.

Along with concurrency, centralized management was a key element of the weapon system philosophy. Each new system was made up of numerous subsystems, each with many components. To meld all of them into a working whole required extensive planning in the design stage and effective integration as development and production proceeded. Since the Air Force lacked enough qualified people and adequate facilities to carry out these functions, it had no alternative but to "buy" acquisition management from industry. According to Brig. Gen. Floyd B. Wood, deputy commander for technical operations in the Air Research and Development Command, the "appalling amount of managerial skill and know-how" required to integrate the thousands of components comprising a modern weapon system has made it "necessary that the Air Force seek managerial help from outside its own organization."[58] In purchasing weapon system management, the Air Force employed three general methods: the "single prime contractor" (also called the "weapon system contractor"), the "systems engineer," and the contractor "team."[59]

In late 1952, the Air Research and Development Command applied the single-prime-contractor method to development only, but in less than a year the Air Force extended it to include production. It took two forms. In one, the single prime contractor had the authority and the funds to subcontract directly for subsystems or components it had designed and the Air Force had approved. The B–58 program, discussed in the next section of this chapter, was the first to employ this contracting technique. In the second form, the single prime contractor still wrote the specifications for subsystems and continued to be responsible for system integration, but the Air Force contracted separately with each of the major subsystem manufacturers, known as "associate" contractors. As a result of these direct relationships with the Air Force, the single prime contractor had limited control over the associate contractors. Although use of a single prime contractor gave industry a much larger role in developing and producing weapons than ever before, the Air Research and Development Command and the Air Materiel Command monitored contractor performance, and the Air Force retained ultimate authority over all phases of system acquisition.[60]

Relying on one contractor—in this period almost always an airframe manufacturer—to perform system integration presented certain difficulties. Early in the 1950s, most aircraft manufacturers lacked staffs with sufficient expertise to carry out this function, particularly with respect to electronic components and missile systems generally. They were also organized functionally and were just beginning to adopt project-type organizations, such as the matrix form, more suited to the systems approach.[61] Finally, subcontractors expressed concern that the weapon system contractor would become their competitor and shut them out of the market by hiring personnel and building facilities of its own to design and manufacture subsystems and components.[62]

To avoid such problems, the Air Force began to employ firms that specialized in systems engineering and systems integration. Composed of administrators, scientists, and engineers, they became part of the Air Force's management team, supplying technical direction to associate contractors responsible for subsystems, and integrating those subsystems into the larger system. These companies were, at the same time, prohibited from developing or manufacturing any of the system's hardware. The earliest and best-known of the systems' integrators was the Ramo-Wooldridge Corporation. Its role in the Air Force's ballistic missile program is covered later in this chapter.[63]

The Air Force did not rely exclusively on industry-based organizations to provide systems engineering and technical direction. The Massachusetts Institute of Technology, through its Lincoln Laboratory, performed this role for the Air Force in the development of the Semi-Automatic Ground Environment (SAGE), a centralized command and control data-processing system. SAGE fed information from radar nets and other sources into a computer that in turn presented an analysis of a potential air threat to human controllers linked electronically with aircraft, surface-to-air missiles, and antiaircraft artillery standing ready to destroy the attacker. In 1958, an element of the Lincoln Laboratory separated from MIT to form the nonprofit corporation MITRE, which continued to provide systems engineering and other technical support for SAGE.[64]

A third contracting approach was the industry "team." In this method, several companies formed a group and submitted a joint proposal for a weapon system contract. Two industry teams, for example, were awarded initial design contracts in 1958 for the Dyna-Soar piloted space vehicle. Boeing assembled a team that included General Electric, Ramo-Wooldridge, Chance Vought, Aerojet General, and North American, while Bell Aircraft and the Martin Company put together another group.[65] Normally one of the firms on an industry team coordinated the group's effort and assumed responsibility for systems engineering, systems integration, and technical direction. In some cases, the team leader became a single prime contractor and the other companies subcontractors; in other instances, each company was an associate contractor but with the lead firm also acting as coordinator and systems integrator.[66] A third variant included companies from two formerly competing teams. In the Dyna-Soar program, for example, in late 1959 the Air Force chose Boeing to be the single prime contractor and Martin, a member of the opposing design team, as an associate contractor to provide the boost engines.[67]

Following the Air Force's decision to give industry much more responsibility in the acquisition process in the early 1950s, evidence appearing in the spring of 1955 that the Soviet Union had significantly reduced the length of the cycle for developing and fielding new aircraft prompted the service to devise procedures for shortening the time required to select contractors for its major systems.[68]

Traditionally, once the requirement for a new system was determined, the Air Force, in what was known as an "open design" competition, solicited detailed proposals (via a "request for proposal") from a large number of manufacturers. For example, as noted in chapter 5, the Air Force sent requests for proposals for the F–102's fire control system to 50 companies and received 18 in response. To process proposals, conduct an evaluation, and make a selection could take the Air Force from one to two years.[69]

To reduce the length of this portion of the acquisition cycle, in 1955 the Air Force instituted new procedures for choosing contractors for its major weapon systems that came to be called the "source selection" process.[70] Instead of soliciting bids industry-wide, the Air Force requested proposals only from firms that it believed capable of developing and producing the system.[71] The Joint AMC-ARDC Source Selection Board, established in the summer of 1955 and composed of senior military and civilian officials from both commands, made this determination based on an assessment of the managerial capability, relevant experience, and resources of all likely competitors.[72] The request for proposal did not require the company to submit a detailed design, as had been the case in an open competition. Instead, the company was asked to state its experience and capability applicable to the system to be acquired, explain how it proposed to organize for the effort, identify the personnel it intended to assign to the project, outline the technical approach it planned to follow, draw up a phased schedule for accomplishing the task, and prepare a cost estimate. The Source Selection Board then evaluated the proposals and usually recommended two or more of the firms to receive a preliminary design and development contract.[73] At this point, as Norman Waks noted in his detailed study of the "source selection" process, the Air Force was choosing not a "what," but a "who"; not the quality of a design but the qualifications of a contractor.[74]

Following approval of the Source Selection Board's recommendations by the field commands and then by Air Force headquarters, the Air Materiel Command let the contracts. As the competing contractors proceeded through the early stages of design and development, the weapon system project office closely monitored their progress. At some point, usually coincident with the fabrication of a mock-up of the system, an on-site Air Force team formally assessed each contractor's effort. Based on the team's evaluation and other data supplied by the weapon system project office, the Source Selection Board recommended one of the competitors, again through the field command–Air Force headquarters channel, to receive the contract for full development.[75]

Along with devising a new process for selecting contractors, the Air Force sought to reduce the length of the acquisition cycle by streamlining its procedures and organizational arrangements for testing new systems. For most of the 1950s, testing proceeded through eight generally sequential "phases." The contractor carried out two of the first three and the Air Research and Development Command four of the first six. The Air Proving Ground Command, which reported directly to the Air Force chief of staff, performed phase seven, "operational suitability" testing, while the using commands executed the last phase with operationally configured systems at one of their bases.[76] In 1957, the Air Force disestablished the Air Proving Ground Command and transferred its functions to the Air Research and Development Command.[77] The principal reasons for the reorganization were a wish to attain economic efficiencies, a belief that operational testing was less relevant in the nuclear age, and a desire to accelerate the acquisition process.[78] The next year the Air Force condensed the eight testing phases into three broad testing "categories."[79] It hoped that the changes would speed testing by eliminating redundancy in the phase arrangement and by allowing some overlap of testing activities. "What had happened," according to Lt. Gen. Roscoe C. Wilson, the Air Force's deputy chief of staff for development, "was that duplicating tests were being run to prove out objectives in different phases. Our tests will, henceforth, be more integrated."[80] Wilson, sensitive to the charge that dissolution of the organizationally independent Air Proving Command might compromise the integrity of the testing process, explained that the Air Force had "guarded against a situation wherein our developer makes final evaluation of his own product . . . by bringing in the operational users early to participate in the test program."[81]

U.S. AIR FORCE TEST AND EVALUATION SYSTEM

Phase Testing (1951–1978)

I:	Airworthiness and Equipment Functioning
II:	Contractor Compliance
III:	Design Refinement
IV:	Stability and Performance
V:	Weather
VI:	Functional Development
VII:	Operational Suitability
VIII:	Unit Operational Employment (1956–1958)

Category Testing (1958–1972)

I:	Subsytem Development and Initial Airworthiness
II:	System Development (Subsystem Integration)
III:	Operational

Source: Fig. 1 (Major Types of Air Force Test and Evaluation), C. E. "Pete" Adolph, *A Career in Test and Evaluation*, 10.

Before the end of the Korean War, the dilemma posed by the need to allow for sufficient testing of new systems while at the same time providing for a force-in-being, adequate in both quantity and quality, resulted in a significant change in the Air Force's production policy. During the rearmament generated by the war and by the force-level requirements of NSC 68, the Air Force made commitments to quantity production of several systems before testing proved the design. One was Boeing's B–47 strategic bomber; another was Republic's F–84F fighter-bomber. In both cases, deficiencies revealed during testing performed after large-scale manufacture began necessitated modifications to the systems, which not only increased costs but also slowed their entry into operational units.[82]

Hoping to solve this problem, the Air Force instituted a new production policy early in 1953. Based on a concept crystallized by Lt. Gen. Orval Cook, the deputy chief of staff for materiel, and Lt. Gen. L. C. Craigie, the deputy chief of staff for development, and approved by the Air Force Council (the Air Staff's policy advisory and program review body), the new policy was known as the "slow buildup" method or the "Cook-Craigie production plan."[83] It provided that production of new systems would be planned at sufficiently low initial rates "to insure adequate time for testing and for agreement on an acceptable production configuration, thereby eliminating the requirement for major modification programs."[84]

Under the slow buildup approach, the Air Force used the initial production run to continue the testing program that began with the system's experimental prototypes. The first 17 production models of both Lockheed's F–104 and Convair's F–106, for example, were scheduled for this purpose, as were the first 30 of the 244 B–58s, also made by Convair, that the Air Force originally planned to buy over a four-year span.[85] Once a system's final configuration was determined, the rate of production would accelerate. The test aircraft that had already been manufactured would themselves be modified on the production line.

The Cook-Craigie concept, often characterized as "fly before you buy," appeared to harmonize nicely with the Wilson Defense Department's determination to realize economies by ensuring that systems were proved by adequate testing before being committed to quantity production (see chap. 8). Early in 1954, Wilfred McNeil, the OSD comptroller, testified before Congress that the Air Force had adopted "a more realistic approach" with regard to scheduling aircraft for production and that the new procedure would "save hundreds of millions of dollars per year previously required for extensive modification of new aircraft."[86] Secretary of the Air Force Talbott echoed this line in his first semiannual report to the secretary of defense for 1954, stating that "before going into quantity production, the Air Force incorporated necessary engineering changes at the least cost in dollars, materials, and time."[87]

Although the slow initial production policy was popular with many Eisenhower administration officials, some in the Air Force believed that it stood in the way of maintaining superiority in weapons technology. The most vocal exponent of this view was Trevor Gardner, the Air Force's top civilian R&D official from early 1953 until his resignation as assistant secretary in 1956. Herbert York, who became the first director of defense research and engineering, later described him as "intelligent, vigorous, somewhat volatile, and impatient to make changes quickly."[88] During his tenure, Gardner was instrumental in securing the Eisenhower administration's designation of the Air Force's ICBM program as the nation's highest military priority and in setting up special organizational and budgetary arrangements to carry it out. But by early 1956, he had become dissatisfied with what he saw as inadequate support for research and development funding by Secretary of the Air Force Quarles and Secretary of Defense Wilson and resigned his position.[89]

After leaving office, Gardner aired his displeasure with the administration's economy measures and the Air Force's approach to weapons acquisition in a series of articles that were published in large-circulation national magazines.[90] In one of these pieces, Gardner blasted the practice of building production slowly:

> The "fly-before-you-buy" policy means that each new airplane must be procured in small quantities initially, and be thoroughly tested over a protracted period of time before large quantity commitments are made. From a budget point of view, this is an excellent precaution. It not only reduces the chances of error but also defers heavy expenses to later years. . . . Unfortunately, no battles will be won by hurling one test model of the world's best airplane into the air when the enemy attacks. Such policy is dangerous to the point of being suicidal.[91]

To meet the threat he saw confronting the nation, Gardner urged that production rates for the F–101, F–102, F–104, and F–105 fighters, all subject to the Cook-Craigie plan, be sharply increased in what he called a policy of "buy—then fly them."[92]

The Defense Department responded quickly to Gardner's charges in remarks it prepared for Leverett Saltonstall, an administration point man on defense matters in the Senate. "The only trouble with this [buy-then fly them] policy," Saltonstall declared, "is that we can't make them fly after we buy." In support of his assertion, the Massachusetts senator cited the F–84F, the F–101A, the F–102, and the B–47 as examples of programs requiring costly modifications after quantity production began. According to Saltonstall, new aircraft systems should follow the deliberate and sequential acquisition path that he claimed had been taken by the B–52. If the Air Force had purchased the original turboprop B–52 configuration in 1948 rather than the eventual jet design, he argued, then "we would have had another failure on our hands today."[93]

Gardner's association of a slow initial production rate with the notion of "fly before buy" was misleading. The Cook-Craigie plan explicitly provided for development and production to occur simultaneously and was entirely consistent with the weapon system concept's emphasis on concurrency. The question was not whether, but rather how much, concurrency. By 1960, with the success of the ballistic missile program, which employed concurrency to an unprecedented extent, and the publication of the 375 series regulations, which made the practice service policy, the Air Force had resolved the issue internally.

Case studies of individual programs are excellent vehicles for observing the changes in Air Force acquisition brought about by the weapon system philosophy in the 1950s. Subsequent chapter sections cover the concept's application in the B–58 medium-range strategic bomber and the ballistic missile programs. They have been chosen because they were among the most important systems acquired by the Air Force during this period and because they illustrate different methods of implementing the weapon system approach.

THE B–58 STRATEGIC BOMBER

The Air Force experimented with the weapon system concept in the F–102 program (see chap. 5), but the first full test of the new acquisition approach took place with the development of a supersonic bomber, the B–58 Hustler. Both Air Force officials and top executives in the Convair Division of the General Dynamics Corporation, the single prime contractor for the program, argued that applying the weapon system concept to the B–58 would cut development time and reduce costs.[94] Neither objective was achieved. The plane did not become operational until mid-1961, about four years later than the Air Force originally expected.[95] Indeed, considering the time that elapsed from program initiation until the first wing was combat ready, the B–58 took longer to field than the B–52, the aircraft most often cited during the 1950s as illustrating the allegedly long weapons development cycle in the United States. In June 1946, the Air Force awarded Boeing the letter contract that initiated B–52 development; the first B–52 wing was combat ready in March 1956—an interval of approximately 9¾ years. In contrast, the B–58 took about 11½ years to complete the same cycle.[96] The B–58 program also experienced significant cost growth. Developing and manufacturing 13 test aircraft, for example, cost $560 million, $215 million more than the original contract estimate, an increase of 60 percent.[97] Furthermore, although it set several speed records, the B–58 did not meet other performance requirements, particularly with respect to range. Several factors contributed to the schedule, cost, and technical performance shortfalls, but the adoption of concurrency in a technologically ambitious program was mostly to blame.[98]

The B–58 exemplified the Air Force's desire during the 1950s for an aircraft that could evade enemy defenses and carry out its mission by flying faster and higher. The delta-winged Hustler, powered by four General Electric J79 engines, was capable of 1,147 knots (1,320 mph), nearing twice the speed of sound and more than twice the maximum speeds of the B–47E (528 knots, 607 mph) and the B–52G (551 knots, 634 mph), its subsonic predecessors.[99] It operated above 63,000 feet, well above the combat ceilings of the B–47 (39,000 feet) and the B–52 (46,000 feet). But compared to those aircraft, the B–58 was small and light—less than 100 feet long with a wing span of 56 feet and an empty weight of 55,000 pounds. The B–47E was 107 feet long, with a wing span of 116 feet, and an empty weight of 89,000 pounds; the B–52G was 157.6 feet long, with a wing span of 185 feet, and an empty weight of 168,445 pounds.[100]

The Hustler's high speed and relatively small size accounted for a major deficiency—inadequate range. When the B–58's performance requirements were first established, the Air Force wanted an unrefueled combat radius of 2,300 nm. But when the B–58 entered operational service, its unrefueled combat radius was only 1,400 nm, not only far below the original standard but also much shorter than the combat radius of the B–47 (2,050 nm) or the B–52 (3,550 nm).[101] Largely because of the B–58's limited range, then-Lieutenant General LeMay, who commanded the Strategic Air Command until mid-1957, consistently opposed its assignment to SAC.[102] In 1955, Maj. Gen. John P. McConnell, LeMay's director of plans, commented wryly that as long as the Soviet Union and not Canada was the enemy, range would matter.[103]

To meet speed and size specifications, the B–58 incorporated several unusual design features. Most noticeable was the aircraft's delta wing. Although a delta-wing configuration was better suited to high-speed flight than conventional swept wings, it still generated considerable drag at transonic and supersonic speeds. To reduce drag, Convair, just as with the similarly configured F–102 interceptor that it was developing at the same time, indented the B–58's fuselage, producing a distinctive "coke-bottle" or "wasp-waist" shape (see chap. 5). Convair employed another design innovation to offset the effects of the extreme heating of exterior surfaces that occurred in supersonic flight—"sandwich" panels that acted as insulators. Making up most of the aircraft's outer skin, each panel consisted of a honeycomb-like metal and fiberglass core pressed between two sheets of stainless steel or aluminum. Instead of bolts and rivets, a special metallic adhesive bonded the panel's components. In addition to resisting the metal fatigue that resulted from high temperatures, the panels were relatively light and strong.[104] According to R. Cargill Hall, a leading B–58 historian, the uniquely fabricated panels "represented the first major departure from the monocoque riveted metal construction techniques of the 1930s, and led eventually to investigations of nonmetallic composite structural methods."[105] To keep the B–58's size and its radar signature to a minimum, Convair's engineers came up with a functional if somewhat unsightly design feature—a compartmented pod that was attached to the underside of the aircraft's fuselage, ran much of its length, and carried a nuclear weapon and fuel. Both the bomb and the pod (emptied of the fuel consumed en route) would be dropped over the target. After the B–58 became operational, four nuclear weapons were mounted on pylons under the wing, two in tandem on each side of the fuselage, freeing the pod for more fuel or other systems.[106]

B–58A Hustler in final assembly.
Courtesy, National Museum of the U.S. Air Force.

The Air Force awarded Convair a contract to develop the B–58 following what amounted to the previously described "source selection" rather than a traditional "open design" competition. After World War II, the Air Force had explored the feasibility of a supersonic bomber through contracts for design studies with both Convair and Boeing.[107] Early in 1951, in the tense atmosphere generated by Communist China's entry into the Korean War, the Air Force decided to expand the contracts, and requested more detailed designs from the two firms.[108] The Air Materiel Command offered several other aircraft manufacturers the opportunity to submit proposals, but this was largely a pro forma gesture given Convair's and Boeing's long head start.[109] In February 1952, after issuing a general operational requirement for a supersonic bomber the preceding December, the Air Force began a formal competition between the two.[110] During the intense head-to-head contest in what was a highly competitive industry, one of Convair's engineers reportedly chalked a warning on a blackboard in an office at the company's Fort Worth plant: "Roses are red, violets are blue; if Boeing gets this one, boys, you're through."[111] In November 1952, judging that Convair's delta-winged design held the greatest promise for meeting the performance requirements expected of the aircraft, the Air Force chose it to develop and manufacture the supersonic bomber. In contrast to Convair's design, Boeing proposed a four-engine aircraft but with conventional swept wings and an internal bomb bay.[112]

The manner of contractor selection was but one of the B–58 program's departures from customary Air Force acquisition practices. Another was that instead of choosing between competing prototypes, as had been the case with the B–47, the B–52, and most other aircraft prior to the Korean War, the Air Force selected Convair over Boeing based solely on an evaluation of paper designs. Furthermore, the choice had been made without much data from wind tunnel tests and before either company had constructed a mock-up of its design. The Air Force believed that paper studies would adequately predict aircraft performance and that waiting on the construction and testing of prototypes would delay fielding the system and cost more money.[113] Also, rather than following the traditional sequential acquisition cycle, the contract with Convair called for development and production to take place concurrently. The first 30 aircraft were to be built on a production line with production tooling and used for testing.[114] Although concurrency had been employed before the Korean War, its application as a matter of policy in the B–58 and many other Air Force aircraft and missile programs initiated in the 1950s constituted a new acquisition protocol.

In yet a fourth major break with the past, the Air Force departed from its usual relationship with industry by designating Convair the B–58's single prime contractor with responsibility for development of nearly all of the aircraft's subsystems and their integration into a complete system. Traditionally, the Air Force contracted separately for an airframe, engines, and other subsystems and equipment items. Normally the airframe manufacturer then assembled the various components, known as Government Furnished Aeronautical Equipment (GFAE, or sometimes simply GFE) into an operating system. Under this procedure, the prime contractor for the airframe had little ability to control either the development schedule or subsystem compatibility. As described in chapter 6, disagreement between Boeing and the Air Force over responsibility for correcting problems with the B–47's fuel tanks and bombing and navigation system, both developed under separate contracts between the Air Force and other companies, caused bitter feelings.

Single-prime contracting was supposed to solve such difficulties. In the B–58 contract, the Air Force made Convair responsible for designing, developing, producing, and delivering a total system. This meant that Convair would prepare the specifications for virtually all of the aircraft's subsystems, determine the companies capable of developing them, subcontract directly with those companies, and oversee the various subcontractors to ensure conformance to specifications and subsystem compatibility. Additionally, Convair was to devise training aids and methods for Air Force personnel who would operate and maintain the B–58, and also develop and procure the aircraft's ground support equipment.[115]

Only the B-58's engines and a few other equipment items would be provided by the government. The Air Force preferred to contract directly for propulsion systems—in this case the J79 engines being developed by General Electric—because it believed that a modern engine took as long and cost as much to develop as an advanced airframe. To pursue multiple engine programs to satisfy essentially the same power requirement for several aircraft would be prohibitively expensive.[116] Even so, Convair was supposed to follow development of the propulsion system closely.[117] Other government-provided equipment would be held to a minimum and, in those instances, the Air Force would be "responsible for meeting the approved component specifications of the contractor from all standpoints of performance, function, and timing."[118]

Although assigning unprecedented and wide-ranging responsibilities to Convair, the Air Force was still actively involved in managing the B–58's acquisition. It monitored the company's plans and progress, approved subsystem specifications and subcontractors, and reviewed testing programs for all systems and equipment not supplied by the government.[119] The Air Force also retained the "final veto power of a customer" in circumstances that might cause the service "serious operational or logistic difficulties."[120]

The Air Force exercised its management role largely through the B–58 weapon system project office. Established in December 1952 and headed by a colonel, the project office not only supervised Convair's activity but also served as liaison between the company and other Air Force organizations. Thus, for example, Convair obtained the assistance of Air Research and Development Command laboratories in determining both subsystem specifications and suitable subsystem contractors through the project office.[121]

Subcontracting was a significant dimension of the B–58 program. Its subcontracting structure was a huge pyramid, reflecting the technological complexity of the undertaking and its nationwide scope. At the top of the pyramid, Convair let contracts for 16 key aircraft subsystems.[122] In turn, these firms subcontracted with large (500 or more employees) and small businesses from a pool of almost 11,000 qualified second- and third-tier subcontractors and suppliers.[123] In late 1960, about the mid-point of B–58 production, 4,800 subcontractors and suppliers, with 24,000 employees located in 45 states, were working on the program.[124] In major weapons acquisition programs, the formation of widespread subcontracting and supply networks has usually been viewed as having potential political implications—a means for both industry and government to attract support for continuing particular programs.[125]

But in addition to its scope, B–58 subcontracting created new industry-to-industry and industry-to-government relationships. In response to fears of the subsystem and major component industry, especially the electronic segment, that the large aircraft manufacturers would begin to develop and produce their own subsystems and components, the Air Force prevented Convair from increasing its manufacturing capabilities beyond the firm's normal airframe activities.

But to enable Convair to fulfill its responsibility as weapon system manager, the Air Force permitted the company to exercise unprecedented oversight of the B–58 subsystem contractors. Convair kept in close touch with them by requiring written reports and by locating a representative or even setting up an office at their plants. The company's authority, written into its contract with each subcontractor, included the power to effect changes in personnel, organization, and development and production plans.[126]

In turning B–58 subsystem management over to Convair, the Air Force found it more difficult to monitor and control the program. Development of the aircraft's troubled bombing and navigation system illustrates how the private-sector subcontracting channel made oversight more problematic for the Air Force. Convair subcontracted the bombing and navigation system to Sperry, which in turn subcontracted the subsystem's radar to Raytheon. Ivan Getting, then vice president of Raytheon and a long-time member of the Air Force's Scientific Advisory Board, recalled how these relationships kept the Air Force in the dark: "We were forbidden at Raytheon to talk to anybody but Sperry. Sperry was forbidden to talk to anybody but Convair, because Convair didn't want anybody to find out what the truth was. At Convair they made all the tradeoffs to their advantage. They pushed all the problems and put all the blame down to the subs."[127]

Initially, the Air Force's procedures for monitoring subcontract performance proved inadequate for the new relationships created by single-prime contracting. Traditionally, surveillance of prime contracts had been carried out by an Air Force official assigned to each major prime contractor's plant, the Air Force Plant Representative, or AFPR. Although not a member of the project office team, the plant representative worked closely with that organization and administered the contract. Due to the extent of the B–58 program, the Air Force representative at the Convair plant had to depend on AFPRs at the plants of the subsystem vendors to administer those subcontracts. But these officials were primarily responsible for prime contracts at those plants; Convair subcontracts were not their first concern. Indeed, during the early stages of B–58 development, according to an officer who was a deputy plant representative at the Convair facility, "there was a predominant trend of thought that the prime contractor [Convair] was the customer and as such the Air Force resident representative at the vendor's [subcontractor's] plant had no responsibilities in the program." To overcome this attitude, the AFPR at the Convair plant hosted periodic conferences that included government contracting officials at subcontractor plants who had been delegated secondary administrative authority over subsystem subcontracts, and representatives of the B–58 weapon system project office, Convair, and the subsystem manufacturers.[128]

In addition to its design and management innovations, the B–58 program pioneered a new contracting form—the cost-plus-incentive-fee contract tied to technical performance. But before discussing this specific contract instrument, it will be useful to describe briefly the basic types of defense contracts. Although the frequency of use of particular contract forms has changed over time and new variations of each have been introduced, the fundamental types have remained essentially the same since World War II.[129]

There are two major types of defense contracts—fixed-price and cost-reimbursement. In a fixed-price contract, the contractor guarantees fulfillment of the contract provisions; in return, the government assures payment of a pre-determined price, except when contracts are adjusted for changes. Fixed-price contracts place virtually all of the risk on the contractor. They are most frequently—but by no means always—employed to manufacture items that have already been developed, have firmly established specifications, and for which significant changes during production are not anticipated. In cost-reimbursement contracts the government assumes most of the project's risks by reimbursing the contractor for pre-authorized types of expenses, called "allowable costs" for items such as labor, materials, and overhead. In addition to reimbursing the contractor for these costs, the government usually awards the contractor a pre-negotiated fee or profit.

Cost-reimbursement contracts are most often used to purchase work entailing considerable uncertainty with respect to technical feasibility and ultimate costs, such as those usually associated with the research, development, and production of new and advanced weapon systems. Cost-reimbursement contracts also impose heavy administrative burdens on both the government and the contractor, primarily in monitoring and auditing the project's allowable costs. During the 1950s, due to the many uncertainties involved in developing sophisticated weapon systems and industry's reluctance to accept the accompanying risk, the government's use of cost-reimbursement contracts increased significantly. In FY 1952, only 12.7 percent of Defense Department procurement dollars were obligated by cost-reimbursement contracts; in FY 1959, that figure had climbed to 40.9 percent.[130]

In the B–58 program, the Air Force employed incentive contracts, a variant common to both the fixed-price and cost-reimbursement forms. Sometimes known as "bonus-penalty" or "reward-penalty" systems, incentive contracts are intended to encourage contractors to reduce costs, meet or exceed a specified schedule, and/or improve the technical performance of the item being developed or manufactured. The principal difference between a fixed-price-incentive contract and a cost-reimbursement-incentive contract is that the former includes a ceiling price for the item that limits the government's cost liability, while the latter has no ceiling price for the work. In an incentive contract tied to costs, the contractor's fee or profit is determined by the amount that costs are below or above a negotiated target cost. The government and the contractor share costs below or above the target cost according to a formula negotiated before the contract award. For example, if the cost-sharing formula is 80/20, the government retains 80 cents and the contractor's fee increases by 20 cents for every dollar that the contractor does not expend below the contract's target cost. In the case of a cost overrun, the government pays 80 cents of every dollar expended over the target cost and the contractor pays 20 cents up to the contract ceiling price. The contractor's profit thus depends to a limited degree on its ability to control costs

The Air Force's five development and production contracts with Convair for the B–58 were all cost-plus-incentive fee contracts.[131] Cost-plus-incentive-fee contracts were not unusual in the 1950s, but until the first B–58 contract was finalized in 1955, such contracts had been related only to costs. The initial B–58 contract gave more weight to technical performance than to schedule or costs—the first use of this type of incentive.[132] The Air Force based one-half of Convair's fee on achieving desired technical capabilities (radius and altitude), one-third on meeting the delivery schedule, and only one-sixth on cost.[133] An Air Force general explained that the multi-incentive nature of the B–58 contract attempted to solve a cost-performance dilemma:

> If you put a squeeze on cost, you run a risk of degradation of performance. If you put pressure on performance, you run the risk of skyrocketing costs. . . . In this contract, we put some incentives that work against each other. We tie an opportunity for increased profit to excellence in performance and delivery. At the same time we tie an opportunity for increased profit to lowered cost. In each instance we provide for penalties in the event that the contractor fails to meet the target on any of the factors involved.[134]

The general's rosy view of the B–58's cost-plus-incentive-fee contract may not have been justified. In his 1964 study, *The Weapons Acquisition Process: Economic Incentives*, Frederic Scherer pointed out that interviews with Convair and Air Force officials conducted in 1958–1959 indicated that the contract's incentive provisions had little influence on the behavior of company employees working on the program. They were motivated more by the opportunity to secure follow-on production orders that a successful system might ensure than by any specific contract incentives tied to cost, schedule, or technical performance. Indeed, with respect to multiple incentive contracts generally, Scherer argues that any incentive for cost reduction will normally give way to considerations of technical performance or schedule when the contractor is faced with conflicts between quality and cost or time and cost. Moreover, he maintains that such non-cost incentives are essentially redundant because "the desire to win follow-on development and production orders and to build a favorable company reputation form the basis of much stronger incentives for quality maximization and schedule maintenance."[135]

It was no accident that the first of the five B–58 contracts emphasized technical performance over both delivery and cost. In 1955, system performance deficiencies were threatening the B–58 program. When first established in late 1951, the new bomber's capabilities were demanding: supersonic speed (unspecified), an operating altitude above 50,000 feet, and an unrefueled radius of 2,300 nm.[136] In the fall of 1952, after Boeing and Convair submitted their designs for the aircraft, the Air Force settled on a specific speed requirement—at least Mach 1.7 but with Mach 2 desired. This requirement set a standard higher than was previously believed possible.[137] Both the Air Force and Convair knew that the performance capabilities expected of the B–58 were beyond the state of the art and that achieving them would require advances in airframe, propulsion, and electronic technology during the course of the system's development.[138]

B–58A Hustler in flight.
Courtesy, National Museum of the U.S. Air Force.

Meeting these ambitious technological goals would have been challenge enough. But there was another complicating factor. In November 1952, at the time the Air Force awarded the B–58 development and production contract to Convair—a selection based almost entirely on evaluation of a paper design—little was known about the aerodynamic effects of transonic and supersonic flight. When wind-tunnel testing revealed that the delta-wing configuration experienced increased drag at these speeds, Convair redesigned the aircraft several times to compensate for the resulting degradation in performance.[139] But even the aircraft's final design, which incorporated the "coke-bottle" indentation and which was approved in September 1954, was still not expected to satisfy all performance requirements, particularly range.[140]

The nearly two-year delay in reaching an acceptable design had significant consequences. Changes in the already space-restricted configuration impacted subsystem design. They also drove up program costs. But most important, the delay, combined with the anticipated performance shortfall, increased SAC's opposition to the B–58 and lessened the enthusiasm of some of the aircraft's advocates. In March 1954, the Air Force reoriented the B–58 program to research and development only. It would buy only 30 test aircraft; Convair was told to scrap plans for developing the training devices and ground support equipment that would be needed if the B–58 were to be produced in quantity for operational use. In June 1955, the Air Force cut back the program even further, reducing the number of test aircraft to be purchased from 30 to 13.[141]

But within two months of the decision to pare the B–58 program to bare bones, the Air Force suddenly reversed course. In August 1955, General Twining, the chief of staff, approved the Air Force Council's recommendation to procure one wing of B–58s.[142] Why the abrupt about face? Historian Cargill Hall suggests that there were two reasons. First, even limited to 13 test aircraft, the B–58 program would cost approximately $500 million. Air Force leaders concluded that they could not marshal sufficient support for so expensive a program that would never produce aircraft for the operational inventory. Secondly, the B–58 appeared to be the only advanced strategic system certain to become available in the early 1960s to replace the B–47 and the B–52. Requirements for the B–70, intended to succeed the B–52, were just being defined, and development of ballistic missiles was not yet far along.[143]

After the decision to produce the B–58 for inventory, the program continued to encounter rough air. The aircraft did not make its first flight until November 1956. The testing program that began at that point revealed numerous subsystem problems. These included difficulties with the J79 engine, the braking system, and the ejection seat (eventually replaced by capsules for each of the three crewmembers). Especially serious, however, was that the aircraft's sophisticated bombing and navigation system was not yet ready for installation.[144]

If the weapon system approach were to realize the time and cost savings advertised by its advocates, then critical subsystems, theoretically designed as part of an integrated system, must all be available at approximately the same time. August Esenwein, head of Convair's Fort Worth Division, incongruously described this management function as making sure the "beer and pretzels" come out even.[145]

Whether beer or pretzels, the Sperry-developed bombing and navigation system lagged well behind the B–58's other major subsystems, causing significant program delays. The capability demanded of the system far exceeded that of bombing and navigation systems in previous aircraft. For example, for a 3-minute bomb run, a B–17 operating at 25,000 feet had to acquire its target 3 miles away; a B–47 flying at 450 knots (518 mph) at 40,000 feet needed 25 miles; but a B–58 at Mach 2 and at an altitude of 50,000 feet required 65–70 miles.[146] The first flight test of the Sperry equipment did not take place until the spring of 1958, and once installed, the complex system proved very unreliable, largely due to its inadequate search radar. Following a review of the B–58 program in early 1960, the Air Force's inspector general concluded: "The low reliability of the Bomb/Nav system had retarded the B–58 test program, required additional funds for the reliability improvement program, and caused excessive support problems."[147] Not until 1967, two years after the B–58 had begun to be phased out of the inventory, was the Air Force able to fix the problem.[148]

The B–58's development difficulties delayed the aircraft's reaching operational status until mid-1961. By this time, the Air Force had decided to field an additional wing. Even so, the total of 116 aircraft (including the 30 test aircraft) that were eventually purchased to support the two wings was less than half the number the Air Force originally intended to buy. The program was expensive, totaling more than $3 billion. Excluding the cost of research and development (more than half the program's cost), the manufacturing price of each B–58 was approximately $12.4 million.[149]

Despite the several speed records that it established, the B–58 may not have been worth its high cost. The aircraft was difficult and expensive to maintain.[150] Its safety record was poor. Twenty percent of the aircraft crashed, largely because the B–58's delta-wing configuration, well-suited for high-speed flight at high altitude, made the plane tough to handle at low altitude.[151] But most telling is that by the time the B–58 entered the operational inventory, the aircraft had outlived its strategic utility. During the decade that it took to develop, produce, and field the B–58, the Soviets dramatically improved their air defenses, introducing advanced interceptors and surface-to-air missile systems that were effective against high-flying targets. The loss of the U–2 to a surface-to-air missile in May 1960 illustrated Soviet defensive capability. To avoid those defenses, aircraft were forced to penetrate at low altitudes. In this respect, the B–58 was quite limited.[152] In 1965, the secretary of defense ordered that the bomber be phased out of the inventory within five years.

Viewed from the perspective of the evolution of the Air Force's acquisition strategy, the B–58 program revealed weaknesses in the weapon system concept. The Air Force had established demanding performance characteristics for the aircraft, but the uncertainties involved in developing new technologies to meet these requirements were not necessarily compatible with key tenets of the weapon system approach. These central principles were that a system should be designed from the outset as an integrated whole and, based upon this plan, work on all of the elements making up the system, including its subsystems and aspects of its employment such as supporting facilities and equipment and training programs, should take place concurrently. When technological monkey wrenches showed up in the B–58 program, the system had to be redesigned or wait for the problems to be solved. As a result, development slowed, some production preparations had to be scrapped, costs rose, and deployment was delayed. But these cautionary signs, especially the B–58 program's employment of concurrency, were obscured by the brilliant success of the weapon system concept's application to ballistic missiles.

THE WEAPON SYSTEM CONCEPT AND BALLISTIC MISSILES

Measured by the attainment of its objective to field an operational ICBM by 1960, the Air Force's ballistic missile program was a stunning success. Historians and other observers have offered a variety of explanations for this favorable outcome. Among them are the technological breakthrough represented by the development of relatively small and light, but high-yield thermonuclear warheads; the top national priority that provided nearly unlimited resources and special organizational arrangements; the political adroitness of the key ballistic missile advocates; and the management philosophy and procedures instituted by General Schriever, the program's dynamic director.[153] Highlighted by extensive use of concurrency, Schriever's management approach was an almost pure expression of the weapon system concept, of which he was an ardent proponent. In 1960, the Air Force, savoring its ballistic missile triumph, made Schriever's methodology the model for acquiring its future systems. In doing so, however, the service may not have sufficiently considered whether those procedures, shorn of the special advantages they enjoyed in the ballistic missile program, would work as effectively when applied to other systems.

In March 1954, Secretary of the Air Force Talbott ordered acceleration of Atlas, the service's ICBM program then under contract to Convair. Two months later, General Twining, the chief of staff, formally implemented the instruction, directing that the program be given the service's highest development priority. Until that time Atlas had been proceeding cautiously and deliberately.[154] The decision to speed up followed a reassessment of the Air Force's ballistic missile effort and a lobbying campaign led by Trevor Gardner, the secretary of the Air Force's special assistant for research and development, and Schriever, then a brigadier general and the assistant for development planning in the Office of the Deputy Chief of Staff for Development on the Air Staff. Enlisting the support of prominent scientists, especially John von Neumann, a mathematician, who was director of the Electronic Computer Program at the Institute for Advanced Study in Princeton, New Jersey, and experienced in military R&D projects, Gardner and Schriever used a crucial selling point: recent information indicated that it would be possible to fabricate high-yield thermonuclear warheads light enough and small enough to be carried by ballistic missiles with intercontinental range. If the United States could develop such missiles, they argued, the nation would have a weapon system far superior to anything possessed by the Soviet Union.[155] On the other side of the coin, should the Soviets score such a breakthrough, the United States would be in mortal danger.

General Bernard Schriever with some of the space and missile systems developed under his leadership.
Courtesy, National Museum of the U.S. Air Force.

General Bernard A. Schriever (1910-2005)

General Bernard Schriever has been called a scientific and technological visionary. Although best-known for developing U.S. intercontinental and intermediate range ballistic missiles during the 1950s, his influence extended well beyond those particular weapon systems.

Born in Bremen, Germany, in 1910, Schriever and his family immigrated to the United States during World War I, settling in San Antonio, Texas. In 1931, he graduated with a degree in architectural engineering from Texas A & M and accepted a reserve commission in the Army. In 1933, he completed flying training at Kelly Field, Texas. For the next two years, he served as a bomber pilot and engineering maintenance officer under Lt. Col. Henry H. ("Hap") Arnold at March Field, California, becoming a protégé of the future Army Air Forces commander (he was married in Arnold's home in the District of Columbia in 1937).

Because he held a reserve commission, Schriever had to leave the Air Corps twice after 1935, but was offered a regular commission in 1938. Between 1939 and 1942, he acquired the credentials that would later make him a leader in the scientific and technical dimension of Air Force activities, completing the Air Corps Engineering School at Wright Field, Ohio, and subsequently earning a master's degree in aeronautical engineering at Stanford. Following graduation in June 1942, then Major Schriever flew B–17s in combat in the Southwest Pacific, rising to the rank of colonel and commander of the Advanced Headquarters, Far East Air Service Command at war's end. In January 1946, Schriever was called to General Arnold's office in the Pentagon and asked by the AAF's commanding general to head a new Scientific Liaison Branch on the Air Staff.

Eight years later, in the summer of 1954, Trevor Gardner, the special assistant to the secretary of the Air Force for research and development, selected Schriever to take charge of the Air Force's ballistic missile program. That he had never worked on a weapon system development project, let alone managed one, was not important. Schriever was an attractive choice for other reasons. As chief of the Scientific Liaison Branch in the Office of the Deputy Chief of Staff for Materiel from 1946 to 1949, he came to know many of the country's leading scientists and engineers, particularly through his involvement with the Air Force's Scientific Advisory Board. Following graduation from the National War College in 1950, Colonel Schriever returned to the Air Staff in the Office of Development Planning under the newly established deputy chief of staff for development. There he made three significant contributions to Air Force acquisition. He devised the system of development planning objectives that sought to integrate new technologies into the requirements formulation process; wrote the Combat Ready Aircraft study that recommended ways to speed up the development cycle while at the same time ensuring that new systems would be fully operational when they reached field units; and, with Gardner and others, worked energetically to secure top priority for the intercontinental ballistic missile among Air Force weapons programs. By the time he was promoted to brigadier general in June 1953, Schriever had established himself as an innovator in Air Force weapons development and a natural choice to direct an accelerated ICBM program.

In April 1959, following the success of the Atlas, Titan, and Thor, and the launch of the Discoverer I satellite that February, Schriever was named to head the Air Research and Development Command and, with the reorganization of Air Force acquisition a year later, became commander of the new Air Force Systems Command. In 1963, the command managed a $7 billion budget (40 percent of the Air Force's total), employed 27,000 military and 37,000 civilians, and oversaw the acquisition of 80 major military systems. When Schriever retired from active duty in 1966, his legacy included not only the hardware developed under his leadership, but also, of equal importance, the adoption by both the Air Force and the Department of Defense of the methods that he employed in managing the acquisition of large, complex, technologically advanced military systems.[1]

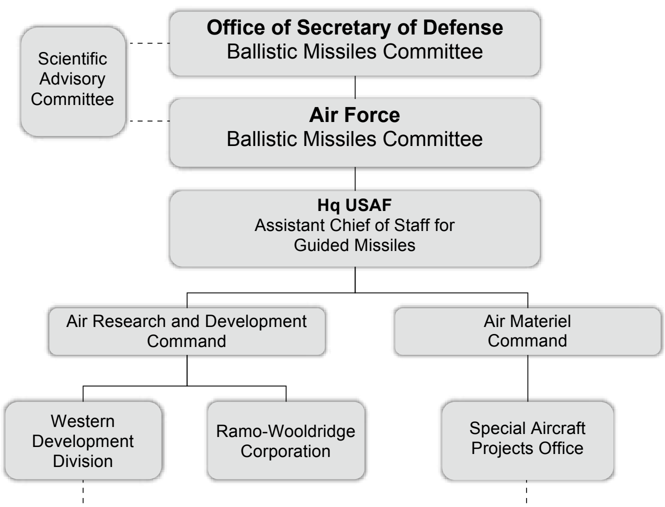
Selected by Gardner to head the Air Force's ballistic missile program, Brigadier General Schriever formally assumed command of the operation, headquartered in Inglewood, California, in August 1954. His task was to produce a "complete" system. Initially, this included not only the missile but also its ground support equipment and plans for its basing facilities, maintenance, and crew training.[156]

To accomplish this mission, Schriever put together an organization with three major elements. The chief component, named the Western Development Division (renamed the Ballistic Missile Division in June 1957), belonged organizationally to the Air Research and Development Command. Schriever was both the division's commander and the deputy for all ICBM-related matters to then-Lieutenant General Power, head of the Air Research and Development Command (and future SAC commander). Schriever's latter hat was important because it afforded him unrestricted access to the Air Research and Development Command's resources.[157] Before taking charge in Inglewood, Schriever sought to obtain control over contracting, production, and logistics for the ballistic missile—functions that would normally have been managed by the Air Materiel Command in the Air Force's bifurcated acquisition structure. "Here," remembers Schriever, "I ran into a hell of a lot of trouble."[158] The Air Materiel Command would not relinquish ultimate authority in these areas, but did agree to set up a separate office to support Schriever. Designated the Special Aircraft Projects Office (renamed the Ballistic Missile Office in March 1956), it constituted the second element of the missile program structure and was colocated with, but organizationally independent of, the Western Development Division. But for all practical purposes, the office's commander worked directly for Schriever.[159]

Trevor Gardner and Maj. Gen. Bernard A. Schriever.
Courtesy, History Office, Space and Missile Systems Center, Air Force Space Command.

The third major part of Schriever's organization was the Guided Missile Research Division of the Ramo-Wooldridge Corporation. The first of the new firms that would specialize in systems integration, the company was founded in the fall of 1953 by Simon Ramo and Dean Wooldridge, both physicists, graduates of Caltech, and former top officials in the Electronics Division of Hughes Aircraft. Its first significant contract was supporting the assessment of the Air Force's intercontinental ballistic missile program initiated by Trevor Gardner earlier that year. Schriever chose Ramo-Wooldridge to be the missile program's system integrator because he and other Air Force officials believed it could attract the scientific and engineering talent needed to develop an ICBM rapidly. Moreover, instead of simply assigning Ramo-Wooldridge an advisory role, Schriever (acting on a suggestion from Donald Quarles, then the assistant secretary of defense for research and development) made it an integral part of his organization with line authority for systems engineering and technical direction over the missile program contractors, including Convair.[160]

AIR FORCE BALLISTIC MISSILE ORGANIZATION
October 1955



Source: Adapted from Chart 5-4 in Jacob Neufeld, *Ballistic Missiles in the United States Air Force, 1945–1960,* 140.

The Air Force's decision to assign Ramo-Wooldridge the role of system integrator rather than Convair, prime contractor for the Atlas program since 1946, departed from Air Force practice and provoked strong opposition from Convair officials. In the summer of 1954, Air Force leaders pushing the ICBM program, especially Schriever, lacked confidence in the company. They believed it was unqualified to manage development of the entire missile system and would be unable to recruit the scientists and engineers essential for an accelerated effort. They may have been influenced, in part, by Convair's problems with the B–58, a high-priority program for which the company had almost complete responsibility, including system integration, but which had been reoriented to research and development only the previous March. And there were other reasons for dissatisfaction. Convair had recommended continued development of its 440,000 lb., 5-engine design for Atlas, but suggested only a feasibility study of the much lighter missile the Air Force's scientific advisers believed possible. It also wanted to develop Atlas' major subsystems, except the engines, in house, which Schriever viewed as a self-serving attempt by the company to expand into fields such as electronics and guidance. These problems, particular to Convair and Atlas, were compounded by the view of Schriever and others that aircraft manufacturers, generally, had not performed well in missile programs (North American's Navaho and Northrop's Snark were eight and four years behind schedule, respectively).[161]

In addition to the organizational structure that he desired, Schriever possessed extraordinary authority for a weapon system program director. Consistent with the top priority enjoyed by the ICBM effort, Lt. Gen. Donald Putt, the deputy chief of staff for development, directed Lieutenant General Power at the Air Research and Development Command to give Schriever "complete control and authority over all aspects" of the program.[162] As a result, not only could Schriever tap ARDC assets, but he could also bypass his parent command and deal directly with other major Air Force commands, the Air Staff, and the Office of the Secretary of the Air Force. Other program managers were limited to a coordinating role that had to be exercised through established channels.[163]

Even this wide-ranging authority soon proved inadequate. Schriever found that the Pentagon's cumbersome approval process slowed progress significantly. To receive a go-ahead for missile development plans, for example, required the concurrence of approximately 40 organizational elements in the Air Force and in OSD. The program faced similar time-consuming gauntlets to obtain approval of its budget and its requests for industrial and military facilities.[164]

To overcome these obstacles, Gardner, Schriever, and their associates skillfully cultivated allies outside the Pentagon—in Congress, on the National Security Council, in the State Department, and especially on the Office of Defense Mobilization's Science Advisory Committee. For most of 1954, the latter's Technological Capabilities Panel, headed by James Killian, president of MIT, had been studying ways new technology might be used to lessen the possibility of a surprise attack. Gardner, along with Lt. Col. Vincent Ford, an Air Force officer and ballistic missile proponent assigned to the Science Advisory Committee, kept Killian's group informed about developments in the Atlas program. In February 1955, the Technological Capabilities Panel urged President Eisenhower to make Atlas the top national military priority.[165] In September, the president responded to this and similar recommendations by signing a National Security Council directive designating the ICBM "a research and development program of the highest priority above all others" and instructing the secretary of defense to "prosecute the program with maximum urgency."[166]

The president's order resulted in streamlined procedures encompassing the entire structure for managing and administering the ballistic missile program—from OSD through Air Force headquarters to the Western Development Division. Known as the "Gillette procedures" (after the name of the head of the Air Force committee that drew them up), the new management arrangements were approved by the secretary of defense in November 1955.[167] They greatly simplified the process of authorizing ICBM planning, programming (connecting plans to budgets and specific time periods), and funding, thereby reducing the time needed to translate plans into action. Heading the list of these reforms was a sharp cutback in the number of organizational elements involved in reviewing the missile program from about 40 to 10.[168] In their place, two powerful new committees that would exercise review and approval authority were established in the Pentagon: the OSD Ballistic Missiles Committee, chaired by the deputy secretary of defense, and the Air Force Ballistic Missiles Committee, chaired by the secretary of the Air Force. In the field, although Schriever coordinated program activities with the Air Research and Development Command, the Air Materiel Command, and the other major Air Force commands, he reported directly only to the Air Force Ballistic Missiles Committee, which in turn worked through its OSD counterpart.[169]

Along with the simplified management structure, another crucial Gillette reform was the adoption of a "package" approach to planning, programming, and funding. Previously the Western Development Division's annual missile development plan, budget proposals, facilities requirements, and numerous other activities, such as arrangements for testing and determination of production quantities, had been reviewed separately. Under the Gillette procedures, all of these program elements were consolidated in the development plan and considered together. Along with its obvious advantages for Schriever's operation, packaging also kept the interrelated nature of the various elements of ICBM acquisition before Pentagon reviewers and decision makers."[170]

By the end of 1955, the intercontinental ballistic missile program had achieved an importance not seen since the Manhattan Project of World War II. It enjoyed the highest national priority, and its director, by virtue of the Gillette procedures, possessed authority exceeded only by that of the head of the wartime atomic bomb effort, Army Maj. Gen. Leslie Groves. But, at the same time, Schriever's responsibilities also expanded. In the beginning, the Western Development Division's task was to develop Atlas and its ground support equipment and to plan for basing, maintenance, and crew training. In November 1955, the Air Force enlarged the mission to include achieving Atlas' initial operational capability (IOC) by April 1959. This assignment meant that

Schriever's team would also be responsible for readying prototype missiles that could be fired in combat and for overseeing design and construction of the first operational bases. In the Air Force's acquisition process, the IOC was normally the responsibility of the using command (SAC in this case).[171] As if this were not enough, the Western Development Division was also tasked with developing an intermediate range ballistic missile. Along with recommending top status for the intercontinental ballistic missile, the Killian panel had pressed for development of either a land or sea-launched IRBM. In December 1955, President Eisenhower, based on Secretary of Defense Wilson's recommendation, approved both types and gave the IRBM programs equal priority to the ICBM. The Air Force assigned Thor, its entry in what would become a vigorous interservice IRBM competition that included the Army's Jupiter and the Navy's Polaris, to the Air Research and Development Command and Schriever. The Western Development Division's work on both the ICBM and IRBM systems would proceed simultaneously.[172]

Western Development Division Headquarters, Inglewood, California, 1954–1955.
Courtesy, History Office, Space and Missile Systems Center, Air Force Space Command.

By the end of 1955, Schriever had assembled the industry team that would build the ICBM. Instead of a single prime contractor managing the entirety of system development, as was the case with Convair in the B–58 program, Schriever selected a system integrator, Ramo-Wooldridge. The company established missile-system specifications, advised the Western Development Division on key technical decisions, and, as part of Schriever's command line, provided systems engineering and technical direction to the numerous "associate contractors" chosen to develop and manufacture the missile's major subsystems. To allay fears of the associate contractors that Ramo-Wooldridge would take advantage of its privileged position in Schriever's organization to become their competitor, the Air Force prohibited the company from engaging in any manufacturing activity related to the missile. In return for this concession, Ramo-Wooldridge received an increased service fee from the Air Force.[173]

To choose the associate contractors, the Air Force adopted the source selection process that had been partially implemented in the B–58 program. Early in 1955, officials from the Western Development Division, the Special Aircraft Projects Office, the Air Research and Development Command, and the Air Materiel Command began to identify the companies most qualified to develop the ICBM's principal subsystems. Those firms were then requested to submit a technical proposal. Next, a board composed largely of representatives from the Air Research and Development Command and the Air Materiel Command evaluated the proposals and recommended its top choices for approval by the two field commands and Air Force headquarters.[174] (As noted earlier in the chapter, the Air Force established similar source selection procedures for all of its major weapon systems later in the year.)

Simon Ramo (left) and Dean Wooldridge at their Ramo-Wooldridge Corporation headquarters, 1954. Courtesy, History Office, Space and Missile Systems Center, Air Force Space Command.

In sharp contrast to other Air Force weapons programs of the day, which had only a single prime contractor and single associate contractors for each subsystem, Schriever selected two contractors for each of the ICBM's major subsystems—airframe (including subsystem assembly), computer, guidance, nose cone, and propulsion. Two important precedents existed for this dual approach, usually described as "parallel development." World War II's Manhattan Project had pursued five methods of extracting fissionable material for an atomic bomb—a reactor pile for plutonium, and the electromagnetic, gaseous diffusion, thermal diffusion, and centrifuge processes for uranium. It had also worked on three bomb designs concurrently—gun types for both the uranium and plutonium bombs, and an implosion device for the plutonium bomb.[175] Similarly, several years before Schriever chose the parallel development approach, Rear Adm. Hyman Rickover, explicitly following the Manhattan Project example, was developing two prototype reactors using different methods of heat transfer in the Navy's nuclear submarine propulsion program—a water-cooled reactor (used in *Nautilus*) and a liquid sodium-cooled reactor (used in *Seawolf*, but not pursued further).[176]

Parallel development seemed to offer several advantages for the ballistic missile program. The Air Force believed it would accelerate acquisition by stimulating competition between the contractors, hedge against the failure of any individual subsystem, make exploration of advanced designs less risky, and promote expansion of the nation's missile R&D and manufacturing capacity.[177] As a result of parallel development, the Western Development Division produced not just one operational ICBM but two—the "stage-and-a-half" Atlas and the two-stage Titan.[178] Additionally, wherever possible, the Western Development Division sought to use ICBM subsystems in developing Thor, the IRBM. Thus, Thor used the same engine developed for Atlas (one of the latter's booster engines) as well as its guidance system and reentry nose cone.[179]

The necessity for speed resonated throughout the ballistic missile program. It lay behind the use of the new process for choosing contractors and was an important factor in the adoption of parallel development. Most of all, urgency determined Schriever's choice of concurrency as the program's development strategy. To cut the time required to build and deploy so complex a system, he wrote, forced us "to undertake all phases of the design-to production-to-operation cycle concurrently, rather than sequentially."[180]

Although the term "concurrency" originated in the ballistic missile program, the concept, insofar as it meant overlapping development and production, was not new. It had been used in a few weapons programs during World War II and was widely practiced by all of the services during the Truman administration's military buildup. Sometimes, as in the case of the Navy's and the Marine Corps' tracked landing vehicle systems, concurrency had been employed in an ill-conceived and undisciplined manner (see chap. 7). In the Air Force by early 1953, concurrency, inherent in the Cook-Craigie production plan, was established

AIR FORCE BALLISTIC MISSILES

Characteristics	ATLAS D	TITAN I	THOR
Height	82.5 ft	98 ft	65 ft
Diameter	10 ft	10 ft (stage 1) 8 ft (stage 2)	8 ft
Weight (fueled)	267,136 lbs	220,000 lbs	110,000 lbs
Thrust	368,000 lbs	300,000 lbs (stage 1) 80,000 lbs (stage 2)	150,000 lbs
Range	6,400 miles	6,300 miles	1,500 miles
Payload	W49 warhead, 1.44 megaton yield	W38 warhead, 4 megaton yield	W49 warhead, 1.44 megaton yield

Source: Lonnquest and Winkler, *To Defend and Deter*, 210, 230, 268-89.

ICBM PARALLEL DEVELOPMENT

Component	ATLAS Contractors	*TITAN Contractors
Airframe/Subsystem Assembly	Convair	Martin
Guidance **Radio-inertial** **All-inertial**	General Electric AC Spark Plug (General Motors)	Bell Telephone Arma Corporation/MIT
Propulsion	North American	Aerojet General
Nose Cone	General Electric	AVCO
Computer	Burroughs	Remington Rand

*The Titan I used radio-inertial guidance. The Arma Corporation's inertial guidance system, originally intended for the Titan, was transferred to the Atlas E and F. The Titan I proceeded with the Bell Telephone Laboratories radio guidance package, while a new inertial guidance system contract with AC Sparkplug (division of General Motors) would be developed by late 1962 for use with Titan II.

Sources: Adapted from Chart 5-2 (Atlas and Titan Contractors) in Neufeld, *Ballistic Missiles in the United States Air Force, 1945–1960*, 132; and Greene, *The Development of the SM-68 Titan*, Vol. I, *Narrative*, 21-26, 114.

acquisition policy. Indeed, concurrency was beginning to expand beyond simultaneity in development and production to include other aspects of system acquisition. In the B–58 program, for example, Convair not only began development and preparations for production simultaneously, but also started work on ground support equipment and training materials.

Schriever expanded the application of concurrency to embrace nearly all of the activities necessary for fielding an operational system. In Atlas, and subsequently in the Titan and Thor programs, launch sites were constructed, support equipment was designed and fabricated, and crews began training even while the missile and its subsystems were being developed and prototypes manufactured and tested, all before each missile's final configuration had been established. Schriever described this as "moving ahead with everything and everybody, altogether and all at once, toward a specific goal."[181]

Advancing simultaneously with "everything and everybody" was an enterprise of immense scope. By 1958, the Atlas, Titan, and Thor programs together involved 18 principal subsystem contractors, more than 200 major subcontractors, and over 200,000 parts suppliers. The subsystem and major subcontractors alone employed over 70,000 people. When military and other government personnel were included, reported *Air Force Magazine*, the total surpassed that "of the gigantic effort that developed the atomic bomb."[182]

To manage concurrent development in each of the three interrelated missile projects, the Western Development Division set up a centralized control system. For each project, Schriever's planning staff established technical objectives and identified milestones that were the tasks to be accomplished to reach program objectives. Progress toward completion of the milestones was monitored by reviewing data contained on standardized reporting forms submitted periodically by the program offices and contractors. All of this information was displayed on charts in a guarded concrete vault known as the "PCR" or Program Control Room. Monthly "Black Saturday" meetings, presided over by Schriever or his deputy, a top official from Ramo-Wooldridge, and the Special Aircraft Projects Office commander, addressed problems peculiar to each missile project.[183] According to historian John Lonnquest, the Western Development Division's management control system, "fostered schedule consciousness, and by breaking the development process down into manageable milestones, allowed Schriever to manipulate [its] different elements. . . ."[184]

But Schriever's management control system, however rigorously applied, does not adequately explain why concurrency worked with Atlas, Titan, and Thor. The most important factor determining the development strategy's success was the ballistic missile program's designation as the top national priority. From this flowed the authority and ample resources that enabled Schriever to implement concurrency effectively. Unlike other weapon system managers, he was able to organize pretty much as he desired and to bypass established review and approval channels to present requirements as a "package" directly to decision makers at the highest levels. Even so, Schriever did not have a blank check. In 1956, the number of IRBMs scheduled for deployment was reduced to decrease costs, and in mid-1957, the entire ballistic missile program's FY 1958 budget was cut by $200 million, overtime restricted, missile delivery rates slowed, and payments to contractors delayed. Nonetheless, the missile program could normally depend on receiving the funds (especially after Sputnik in the fall of 1957) and people that were needed.[185] Retired Lt. Gen. Otto Glasser, then a colonel and the Atlas program director beginning early in 1955, recalls the general feeling that

Schriever's organization "was stealing all the money and all the good people and getting away with murder."[186] Indeed, although never officially admitting they existed, the Air Force regularly covered budget overruns on the missile projects by transferring money from other programs.[187] Also, along with the outstanding scientists and engineers recruited by Ramo-Wooldridge, Schriever was able to handpick the Air Force officers and civilian employees assigned to his organization.[188]

Titan I production, Glenn L. Martin Company, February 1958.
Courtesy, History Office, Space and Missile Systems Center, Air Force Space Command.

The ballistic missile program's priority also made it possible to adopt development approaches that allowed cutting-edge technologies to be exploited. Parallel development, for example, enabled the Western Development Division to pursue the more advanced, but unproven, on-board, all-inertial guidance system with Titan (Schriever called it the "biggest gamble"), while using the more limited but reliable ground-based, radio-inertial guidance on Atlas.[189] Other programs would ordinarily have been forced to choose one or the other with the risk of delay or failure had the unproven technology been selected.

Schriever believed that the application of concurrency in the ballistic missile program saved both time and money.[190] The evidence that concurrency saved time seems undeniable. Atlas was ready to launch in the fall of 1959, just a couple of months behind the schedule established in the fall of 1955, and well in advance of the Air Staff's original objective of fielding an operational ICBM by mid-1960.[191]

Most historians, however, do not support Schriever's assertion that concurrency cut costs. Jacob Neufeld, author of the Air Force's official history of the ballistic missile program, maintains that concurrency proved to be "very costly."[192] John Lonnquest, who has studied the issue most closely, suggests that although concurrency might have reduced some overhead expenses by shortening the time between design and production, it increased costs elsewhere. He cites construction of the Atlas F launch silos to illustrate the point. Silo construction began while the missile was still under development, but modifications to the missile required corresponding changes to the silo configuration, ultimately raising the cost of the launch facilities from $23 million to more than $50 million.[193]

Whether concurrency saved money, however, was not the issue in the 1950s. All along, Schriever's primary concern was to deploy an operational missile before 1960. To achieve this objective, his organization not only subordinated cost to schedule but, unlike most other Air Force weapons programs of the period, technical performance to schedule as well. When SAC declared the 564th Strategic Missile Squadron operational in September 1960, the command knew that the unit's Atlas Ds could not be counted on. In October, General Power, SAC's commander, wrote General White, the Air Force's chief of staff: "I am convinced that at the present time the Strategic Air Command does not have an operationally reliable Atlas D missile system." To support his claim, Power noted that of the missile's 16 test launches, only 7 had gotten off the ground, and only 3 of those had impacted within the target area.[194]

The Ballistic Missile Division, the Western Development Division's successor, was well aware of Atlas' (and also Titan's) reliability shortfalls. For one thing, in order to meet the scheduled date for initial operational capability, the thorough testing regimen, normally characteristic of the Air Force acquisition process and designed to reveal deficiencies, had been sharply abbreviated. Beyond this, concurrency tended to magnify the problems associated with incorporating design changes. Modifications in one system element often required changes in numerous others. But by the time the first missiles were turned over to SAC, Schriever's organization had not yet developed adequate configuration control procedures that linked design changes to hardware production. For example, the lack of such procedures resulted in some switches being manufactured without standard specifications, thus increasing the possibility of malfunction.[195]

Beginning in the fall of 1959 with the solid-fuel Minuteman, the next generation ICBM, then in its second year of development, the Ballistic Missile Division began to apply a configuration control system copied in part from quality assurance procedures employed by Boeing in its military and commercial aircraft programs.[196] It involved formal and disciplined processes for testing, inspection, and quality control. Not only did the system link specifications to designs, designs to hardware, and hardware to testing and operational procedures, but its data also could be used to relate proposed design changes to contract costs and schedule impacts—enabling managers to gain financial as well as technical control of a project.[197] Eventually the configuration control procedures developed by the Ballistic Missile Division became part of what has been described as the "Inglewood model" of systems management.

Thor IRBMs on station in England.
Courtesy, History Office, Space and Missile Systems Center, Air Force Space Command.

As indicated earlier in the chapter, the principal objective of the Weapon System Management Study Group formed by General LeMay in 1959 was to apply the methods used by Schriever in the ballistic missile program to other Air Force systems. With the publication of the 375 series regulations in the summer and fall of 1960, the Air Force made the "Inglewood model" of weapon system management standard procedure throughout the service. The regulations captured the essence of the ballistic missile program's management approach. Air Force Regulation (AFR) 375-1 (Weapon/Support Systems Management) defined systems management and outlined the concept for its employment, emphasizing that selected high-priority weapon and support systems would be "managed as complete, integrated, packaged programs." In what was likely the first important official use of the term "acquisition" in the Department of Defense, the regulation divided a weapon system's life cycle into three main phases: conceptual, acquisition, and operational. The acquisition phase encompassed development and production.[198] AFR 375-2 identified the responsibilities of the system program office, successor to the weapon system project office, and AFR 375-3 specified the responsibilities and authority of the system program director.[199] The latter regulation appeared to give program directors significantly more authority than the limited planning and coordinating power exercised by the former weapon system project officers. It included "planning, organizing, integrating, and coordinating, and monitoring the system-oriented activities of all participating field agencies and for directing those activities in consonance with the approved system program." The system program director was also empowered to reschedule programmed events, reapply funds designated for the system, and to effect cost, schedule, and technical performance tradeoffs.[200] Finally, AFR 375-4 required that a reliability program be established for all systems.[201]

The institutionalization of Schriever's management methods in the 375 series regulations came at a price. The publication of the regulations was part of a reconfiguration of the Air Force's process for formulating operational requirements and controlling the development of weapon and support systems that was instituted during the summer and fall of 1960.[202] The revised process provided for package treatment of several large-scale systems in addition to those being developed by the Ballistic Missile Division.[203] But ironically, it also subjected Ballistic Missile Division programs to Air Staff review and approval, thus undermining the streamlined Gillette procedures that helped to make the Inglewood operation so effective.[204] Even so, writes Stephen Johnson in his insightful study of Air Force acquisition in the two decades following World War II, the organization and management methods developed by Schriever and his team "became the model for USAF large-scale technology development."[205]

* * * * *

During the 1950s, the Air Force developed a systems approach to acquiring its large-scale, advanced technology weapons. Known as the weapon system concept, the management philosophy promised to reduce both the time and costs involved in weapons acquisition. To accommodate the new approach, the service adjusted its established acquisition organization and processes. It evolved a cross-disciplinary organizational structure, the weapon system project office, to manage development at field level. It also adopted new or modified long-standing practices more suitable to the weapon system concept's emphasis on reducing acquisition cycle time, such as the source selection process for choosing contractors, streamlined testing protocols, and the Cook-Craigie policy that provided for regulated overlapping of development and production activities.

Implementing the weapon system concept required highly centralized management. But because the Air Force lacked the personnel and facilities necessary to manage the design, development, and production of complex weapon systems, it purchased these resources from both industry and the nation's academic community. Industry played the largest role, and, throughout the decade, the Air Force experimented with a variety of ways to employ firms in managing weapon system acquisition. The two most significant were the single-prime-contractor method evident in Convair's role in the B–58 program and the system-integrator approach exemplified by Ramo-Wooldridge's participation in ballistic missile development. But no matter the extent of industry's involvement, the Air Force retained final decision authority.

Along with centralized management, concurrency was an integral feature of the weapon system concept. Although employed on a smaller scale in other systems, concurrency received its most extensive application in the ballistic missile program. Based on that success, in 1960 the Air Force established concurrency, together with the management procedures Schriever's organization had developed to implement it, as the model for acquiring other major weapon and support systems. In doing so, however, the Air Force did not take sufficient account of the key reason the ballistic missile program succeeded: it had enjoyed the nation's highest priority, ensuring Schriever the authority and resources required to make concurrency work. The number of programs that could be accorded such status was obviously limited. The B–58 program, in which concurrency was a failure, illustrated another of that acquisition strategy's limitations: performance requirements that were too far beyond the state of the art drained resources and risked support for the program.

Endnotes

1. On 2 September 1960, the 564th Strategic Missile Squadron, equipped with six Atlas Ds and located at Francis E. Warren Air Force Base, Wyoming, became the first operational ICBM squadron. See Jacob Neufeld, *Ballistic Missiles in the United States Air Force, 1945–1960*, 208, 234.
2. Marcelle Size Knaack, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems*, Vol. I, *Post–World War II Fighters, 1945–1973*, 93 (note 6), 94; and *Splendid Vision, Unswerving Purpose:*

Developing Air Power for the United States Air Force during the First Century of Powered Flight, 298, 308.
3. For analysis of the bomber gap, see Richard M. Leighton, *Strategy, Money, and the New Look, 1953–1956*, 379-98. For the missile gap, see Peter J. Roman, *Eisenhower and the Missile Gap*.
4. Neufeld, *Ballistic Missiles*, 102, 117.
5. See Knaack, *Post–World War II Fighters*, 36; and Walton S. Moody and Warren Trest, "The Air Force as an Institution," chap. 13 in *Winged Shield, Winged Victory*, Vol. II, *A History of the United States Air Force*, ed. Bernard C. Nalty, 103.
6. Statement of General Nathan F. Twining, Chief of Staff, United States Air Force, to the Committee on Appropriations, House of Representatives in Connection with the FY 1955 Budget, ca. early 1954, folder 4, box 15, series 4, Papers of Gen. Nathan F. Twining, Special Collections Branch, Robert F. McDermott Library, United States Air Force Academy, Colorado. Twining added: "This capability to provide immediate and powerful atomic support will compensate considerably for Allied deficiencies in other fields."
7. Ltr, Gen. Nathan F. Twining, Chief of Staff, United States Air Force, to Maj. Gen. Patrick W. Timberlake, Commander, Air Proving Ground Command, 15 March 1955, folder Aircraft 1955, box 74, Twining Papers, LC.
8. Neufeld, *Ballistic Missiles*, 117.
9. When launched at high altitude and flying at supersonic speed, the Hound Dog's range was 500 nm; at low altitude and subsonic speed, the range dropped to 200 nm. The Air Force's first air-to-ground missile was the Rascal. Developed by Bell Aircraft, the rocket-powered Rascal was also inertially guided and could carry a 3,000 pound nuclear warhead 90-100 nm. Intended primarily for the B–47, the Rascal proved unreliable, never proceeded beyond the testing stage, and was cancelled in November 1958. See Marcelle Size Knaack, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems*, Vol. II, *Post–World War II Bombers, 1945–1973*, 47 (notes 72-75), 128-30, 128 (note 47), 271 (note 61), 275.
10. Robert J. Watson, *Into the Missile Age, 1956–1960*, 33.
11. For the Air Force's development of ever-faster, ever-higher flying, and in other respects more capable aircraft during this period, see Mark A. Lorell and Hugh P. Levaux, *The Cutting Edge: A Half Century of U.S. Fighter Aircraft R&D*, 51-72; Mark A. Lorell, *Bomber R&D Since 1945: The Role of Experience*, 11-30; and Richard P. Hallion, "A Troubling Past: Air Force Fighter Acquisition since 1945," *Airpower Journal* 4, no. 4 (Winter 1990): 4-23.
12. Knaack, *Post–World War II Bombers*, 397.
13. Knaack, *Post–World War II Fighters*, 188-89, 205. As capabilities were added, Air Force fighters tended to become heavier. The F–100D weighed 21,000 pounds; the F–101B, 28,000 pounds; the F–102A, 19,460 pounds; the F–105D, 27,500 pounds; and the F–106A, 23,646 pounds (all empty weights). The F–104 Starfighter was an exception to the trend. The tactical fighter variant of the aircraft, the F–104C, weighed 14,082 pounds (empty). See table 2 (Selected U.S. Air Force Jet Fighters, 1947–1962), in Lorell, *Bomber R&D*, 13.
14. Knaack, *Post–World War II Fighters*, 330-31; and Knaack, *Post–World War II Bombers*, 564. Neither aircraft was ever deployed. In late 1959, the F–108 was cancelled as an economy move, never proceeding beyond the mock-up stage. The Kennedy administration decided that the B–70's strategic usefulness was limited and restricted the program to the fabrication of a small number of prototypes. Two were eventually built and both flew, but the second was destroyed in a mid-air collision with an F–104 in May 1966. The Air Force transferred the remaining XB–70 to the National Aeronautics and Space Administration for use in flight research.
15. The two booster engines on the Atlas D generated a combined 368,000 pounds of thrust; the single sustainer engine, 57,000 pounds. See John C. Lonnquest and David F. Winkler, *To Defend and Deter: The Legacy of the United States Cold War Missile Program*, USACERL Special Report 97/01 (n.p.: Department of Defense Legacy Resource Management Program, Cold War Project, November 1996), 210.
16. For the Air Force space program during the Eisenhower administration, see David N.

Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, 29-95.
17. Lt. Col. J. W. Colopy, "Weapon Systems and the Weapon System Concept," *Air University Quarterly Review* 9, no. 2 (Spring 1957): 107.
18. "Deficiencies in the AF Electron Tube Development Program," 1, encl. to ltr, Lt. Gen. Thomas S. Power, Commander, Air Research and Development Command, to Deputy Chief of Staff, Development, Headquarters, USAF, 23 November 1955, sub: Fund Deficiency in Applied Research and Exploratory Development in the Area of Electron Tubes and Transistors, folder Air Research Command, box 75, Twining Papers, LC.
19. Maj. Gen. David A. Baker, "U.S. Air Force Procurement," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 26 January 1955, 21, NDU Library.
20. Historical Division, Office of Information Services, Headquarters, Air Research and Development Command, United States Air Force, *History of the Air Research and Development Command, 1 January–30 June 1956*, Vol. I, *Narrative*, 41, file K243.01, AFHRA.
21. Martin Van Creveld, *Technology and War: From 2000 B.C. to the Present*, 268.
22. In 1953, in deference to the weapon system concept, the joint project office began to be called a weapon system project office (WSPO). In 1960, the Air Force changed the name to system program office (SPO), recognition that most support systems were not traditional "weapons" designed for combat and that "projects" had become "programs." See Air Force Regulation 20-10 (Weapons Systems Project Offices), 16 October 1953; and Air Force Regulation 375-2 (System Program Office), 31 August 1960. Copies of Air Force regulations, from the founding of the Air Force in 1947 to the present, are located in the Air University Library, Maxwell Air Force Base, Ala.
23. Memo, Trevor Gardner, Special Assistant to the Secretary of the Air Force, Research and Development, for Mr. Douglas [James H. Douglas, Jr., under secretary of the Air Force], 29 May 1953, sub: ARDC-AMC Relationships, folder Policy and Organization 321.1, box 17, entry 10 (Decimal Correspondence of the Special Assistant to the Chief of Staff Relating to the Organization of Research and Development Activities), RG 341.
24. W. B. P. [Lt. Gen. Williston B. Palmer, U.S. Army] memorandum for record, 17 July 1953, sub: Research and Development Organization—General Twining's Views, folder 201-45, Organization and Functions, 1951–1953, box 1, entry 40 (Records of the Office of the Chief of Research; Records Relating to Army Research and Development Activities, 1943–1960), RG 319. The Army's leadership was then considering whether to separate responsibility for research and development from the assistant chief of staff for logistics, G–4, on the Army staff and establish it as a new assistant chief of staff position, G–5. See chap. 11 in this volume.
25. Memo, Lt. Gen. E. E. Partridge, Deputy Chief of Staff, Operations, Headquarters, USAF, for General Doolittle [Lt. Gen. James H. Doolittle, USAF, Ret., special assistant to the chief of staff], 24 July 1953, sub: Consolidation of AMC-ARDC, folder Policy and Organization 321.1, box 17, entry 10, RG 341; ltr, Lt. Gen. D. L. Putt, Commander, Air Research and Development Command, to Doolittle, 24 July 1953, ibid.; memo, Brig. Gen. George E. Price, Director of Requirements, Office of the Deputy Chief of Staff, Development, Headquarters, USAF, for General Craigie [Lt. Gen. Laurence C. Craigie, deputy chief of staff, development], atch to memo, Price for Doolittle, 29 July 1953, sub: AMC/ARDC, ibid.; ltr, Roy T. Hurley, Chairman and President, Curtiss-Wright Corporation, to Putt, 24 August 1953, folder Air Research and Development Command, box 16, entry 10, RG 341; memo, unsigned, for Secretary Talbott, 2 September 1953, folder Ready File, General Twining, 1953, box 120, Twining Papers, LC; memo, H. Lee White, Assistant Secretary of the Air Force, Management, for Talbott, 22 September 1953, folder H. Lee White Report, box 30, entry 366C (Office of the Assistant Secretary of Defense [Comptroller]; Office of the Director for Plans and Systems; Hoover Commission Files), RG 330; memo, Harold E. Talbott, Secretary of the Air Force, for the Chief of Staff, U.S. Air Force, 1 October 1953, folder Secretary of the Air Force (1), box 64, Twining Papers, LC; and memo, Gen. Thomas D. White, Vice Chief of Staff, for All Deputy Chiefs of

Staff, Directors, Chiefs of Comparable Offices, 6 October 1953, sub: Realignment of Research and Development Functions and Organization in the USAF, folder Policy and Organization 321.1, box 17, entry 10, RG 341.

26. Secretary of the Air Force Order 100.1, 8 February 1955, sub: Functions of the Under Secretary and Assistant Secretaries of the Air Force and Special Assistants to the Secretary of the Air Force, folder Secretary of the Air Force, Assistant and Under Secretary, 1955, box 81, Twining Papers, LC.

27. Memo, Gen. N. F. Twining, Chief of Staff, for Secretary Talbott, 11 April 1955, sub: Realignment of DCS/Development Responsibilities, folder Secretary of the Air Force (1), 1955, box 81, Twining Papers, LC; and memo, Gen. Thomas D. White, Vice Chief of Staff, for All Deputy Chiefs of Staff, Directors, and Chiefs of Comparable Offices, 14 June 1955, sub: Realignment of Research and Development Functions and Organization in the Air Force, folder Organization, 1955, box 79, Twining Papers, LC.

28. Bernard A. Schriever, interview by Maj. Lyn R. Officer and Dr. James C. Hasdorff, U.S. Air Force Oral History Program, 20 June 1973, Washington, D.C., 23, file K239.0512-676, AFHRA [hereafter Schriever interview 1973].

29. Air Force Regulation 20-10 (Weapon System Project Offices), 10 August 1954, 1.

30. The major systems included the F–100 fighter-bomber, the B–47 bomber, the B–52 bomber, the F–101 fighter-interceptor, the F–102 fighter-interceptor, the F–105 fighter-bomber, the F–106 fighter-interceptor, the F–107 fighter-bomber, the B–58 bomber, the B–70 bomber, the Skybolt air-to-surface missile, the Snark and Navaho cruise missiles, and the Thor, Atlas, and Titan ballistic missiles. See Michael E. Brown, *Flying Blind: The Politics of the U.S. Strategic Bomber Program*, 330-31.

31. U.S. Air Force Scientific Advisory Board, *Report of the Ad Hoc Committee on Research and Development* [hereafter *Report of the Ad Hoc Committee on Research and Development*], June 1958, 24-26, copy attached as tab G, item 5, Summary Agenda of the Ninth Meeting of the Defense Science Board, 14 August 1958, box 834, Subject Files (Research and Development, 1953–1960), OSD/HO; Margaret C. Bagwell, *Buying the USAF Aerospace Force*, in Historical Division, Office of Information, Headquarters, Air Force Systems Command, United States Air Force, *History of the Air Force Systems Command, 1 July–31 December1961*, Vol. II, 10-6, file K243.01, AFHRA; and Michael H. Gorn, *Vulcan's Forge: The Making of an Air Force Command for Weapons Acquisition (1950–1985)*, Vol. I, *Narrative*, 51, 55-56.

32. For the responsibilities of the weapon system project office, see Air Force Regulation 20-10 (Weapons Systems Project Offices), 16 October 1953; Air Force Regulation 20-10 (Weapon System Project Offices), 10 August 1954; Air Force Regulation 20-10 (Weapon System Project Offices), 24 March 1958; Air Materiel Command Pamphlet, *AMC Concept of Weapon System Integration*, 14 February 1958, in *History of the Air Materiel Command, 1 July–31 December 1957*, Vol. II, *Supporting Documents*, doc. no. 38, 13-29, microfilm roll K2006, Air Force History Support Office, AFHSO, Bolling Air Force Base, Washington, D.C.; Air Force Pamphlet no. 25-2-1, *Weapon System Management*, 30 June 1959, 6-9, copy in NDU Library; Air Research and Development Command and Air Materiel Command Brochure, *Weapon System Management and the Weapon System Project Office*, 17 August 1959, 11-30, copy in NDU Library; Claude Witze, "Industry-AMC Partnership Tackles Aerial Weapons Systems Complexity," *Aviation Week* 61, no. 7 (16 August 1954): 97, 100, 104; and Colopy, "Weapon Systems," 109-13.

33. Historical Division, Office of Information, Headquarters, Air Research and Development Command, United States Air Force, *History of the Air Research and Development Command, 1 January–31 December 1958*, Vol. I, 102, file K243.01, AFHRA.

34. Colopy, "Weapon Systems," 110. In 1959, the F–108 weapon system project office was staffed by 40 to 50 people. See "The WSPO Concept: Space Age Procurement," *Armed Forces Management* 5, no. 5 (February 1959): 18.

35. Surveys and Investigations Staff, House of Representatives Committee on Appropriations,

A Report to the Committee on Appropriations, U.S. House of Representatives, on Procurement Policies and Practices, Department of Defense, January 1956, 42-43, box 2, entry 160A (Assistant Secretary of Defense, Supply and Logistics, Secret Files, 1956), RG 330. The observer also reported: "The JPO [joint project office] people complained that they were always making reports to Generals and other officers at staff level. Supervisory personnel were often preparing for briefings and presentations of various problems. It became so exasperating, one top AF civilian said, that the only way he could get his work done was to come to the base on Saturdays."

36. Colopy, "Weapon Systems," 110; and Air Research and Development Command and Air Materiel Command Brochure, *Weapon System Management and the Weapon System Project Office*, 20-30.

37. Staff Papers Prepared for the Ad Hoc Study Group, *Program for Reducing the Time Cycle from Concept to Inventory*, Vol. V, *A More Vigorous Project Management*, 1956, 19, folder A20, vol. 3, box 123, entry 1004I (Secret General Correspondence, 1956), RG 72 [hereafter More Vigorous Project Management study].

38. Ltr, Col. Victor R. Haugen, Chief of Staff, Wright Air Development Center, to Deputy Chief of Staff, Personnel, Air Research and Development Command, 19 November 1953, sub: Qualification Criteria for Air Force Project Officers, tab E to "Validating Tables of Distribution: A Staff Study Prepared by Personnel Plans Division, Directorate of Personnel, Headquarters, Air Research and Development Command," 1 March 1954, in Historical Division, Office of Information Services, Headquarters, Air Research and Development Command, United States Air Force, *History of the Air Research and Development Command, 1 January–30 June 1954*, Vol. II, *Supporting Documents*, doc. no. 18, file K243.01, AFHRA.

39. More Vigorous Project Management study, 18. The study did not indicate the percentage of project officers with an aeronautical rating (pilot or navigator).

40. Ibid., 18, 21.

41. Ibid., 8-17, 19-22.

42. For the Weapon System Phasing Group, see ibid., 16-17; Air Materiel Command Pamphlet, *AMC Concept of Weapon System Integration*, 29-32; Air Force Pamphlet no. 25-2-1, *Weapon System Management*, 9-11; Air Research and Development Command and Air Materiel Command Brochure, *Weapon System Management and the Weapon System Project Office*, 35; Witze, "Industry-AMC Partnership," 100; and Col. Ralph T. Holland, "Weapon System Management: A Critical Investigation of the Air Force System for Controlling Major Weapon Systems," Air War College thesis, Air University, Maxwell Air Force Base, Ala., April 1959, 28-36. Copy in Air University Library.

43. Memo, Gen. Thomas D. White, Chief of Staff, for General LeMay, 23 September 1957, folder Chief of Staff Memorandums, box 5, Papers of Gen. Thomas D. White, U.S. Air Force [hereafter White Papers], LC.

44. *Report of the Ad Hoc Committee on Research and Development*, 5-6, 25-26; and Thomas A. Sturm, *The USAF Scientific Advisory Board: Its First Twenty Years, 1944–1964*, 84-87. The committee (and its report) was often referred to by the name of its chairman, H. Guyford Stever, associate dean of engineering at the MIT and vice chairman of the Scientific Advisory Board.

45. W. D. Putnam, *The Evolution of Air Force System Acquisition Management*, 13-14.

46. Knaack, *Post–World War II Bombers*, 206-07, 236.

47. *SAC Missile Chronology, 1939–1988*, 3, 22.

48. Ibid., 9, 22.

49. Gorn, *Vulcan's Forge*, 63.

50. Putnam, *System Acquisition Management*, 15.

51. Ibid., 16.

52. Otto J. Glasser, interview by Lt. Col. John J. Allen, U.S. Air Force Oral History Program, 5-6 January 1984, Washington, D.C., 95, file K239.0512-1566, AFHRA [hereafter Glasser interview].

53. Putnam, *System Acquisition Management*, 15; and Bagwell, *Aerospace Force*, 41.
54. Putnam, *System Acquisition Management*, 17-18.
55. In 1948, the Air Force had established an office (eventually named the Office of Air Research) in the Air Materiel Command with responsibility for basic research. In 1951, the Office of Scientific Research (AFOSR) was created in the Air Research and Development Command to oversee the Air Force's research activities. In 1960, the AFOSR was succeeded by the Air Force Research Division (AFRD) and charged with managing ARDC's basic and applied research programs. As part of the 1961 reorganization, the AFRD was redesignated the Office of Aerospace Research and made a separate reporting agency under Headquarters, U.S. Air Force. For the evolution of the research function in the Air Force through the early 1960s, see Nick A. Komons, *Science and the Air Force: A History of the Air Force Office of Scientific Research*.
56. John Lonnquest, "Building Missiles: Concurrency and the Legacy of the Early Air Force ICBM Program," in *Providing the Means of War: Perspectives on Defense Acquisition, 1945–2000*, ed. Shannon A. Brown, 102.
57. Maj. Gen. Osmond J. Ritland, "Concurrency," *Air University Quarterly Review* 12, nos. 3 and 4 (Winter and Spring 1960–1961): 240.
58. Cited in "Weapon System Plan Outlined to IRE [Institute of Radio Engineers]," *Aviation Week* 60, no. 13 (29 March 1954): 44.
59. For a contemporary discussion of the three approaches, see J. Sterling Livingston, "Weapon System Contracting," *Harvard Business Review* 37, no. 4 (July–August 1959): 83-92.
60. Ltr, Maj. Gen. Donald L. Putt, Vice Commander, Air Research and Development Command, to Commanding General, Wright Air Development Center, 8 December 1952, sub: General Policy Guidance on Use of a Single Prime Contractor for Development of a Complete Weapon System, folder T-10.06, file 168.7265-237, 1952–1954, Demler Papers, AFHRA; Robert J. Reed, "New AF Policy Means More Competition—More Selling," *Aviation Age* 20, no. 2 (August 1953): 21-23; Air Force Regulation 70-9 (Procurement and Contracting: Weapon System and Supporting System Procurement), 12 November 1953; Historical Division, Office of Information Services, Air Research and Development Command, United States Air Force, *History of the Air Research and Development Command, 1 January–31 December1953*, Vol. I, *Narrative*, 360, 362, 367-75, microfilm role K2836, AFHSO; Putnam, *System Acquisition Management*, 7; Brown, *Flying Blind*, 177-78; and Stephen B. Johnson, *The United States Air Force and the Culture of Innovation, 1945–1965*, 51-52.
61. Reed, "More Competition—More Selling," 22; Edward G. Uhl, "Applying the Systems Method to Air Weapons Development," *Aviation Age* 21, no. 2 (February 1954): 21-23; William B. Bergen, "New Management Approach at Martin, *Aviation Age* 21, no. 6 (June 1954): 36-49; Neufeld, *Ballistic Missiles*, 111; and Johnson, *Culture of Innovation*, 64-65, 102-10.
62. Reed, "More Competition—More Selling," 22; "Weapon System Plan Spurs Development," *Aviation Week* 59, no. 7 (17 August 1953): 85; Maj. Charles L. Walker [deputy assistant for programming, Headquarters, San Bernardino Air Materiel Area, Air Materiel Command], "Impact of the Weapon System Concept on the Accessory Manufacturer," address to the Accessory and Equipment Technical Committee of the Aircraft Industries Association, Los Angeles, Calif., 21 October 1953, Air Force Systems Command file 400.451, Historical Office Archives, Air Force Materiel Command, Wright-Patterson Air Force Base, Oh.; Philip Klass, "Battle Over Avionics Dollar Sharpens," *Aviation Week* 61, no. 26 (27 December 1954): 42-44, 49-50; Philip Klass, "When is Your Customer a Competitor?" *Aviation Week* 62, no. 1 (3 January 1955): 56-58, 62, 64; and Claude Witze, "AF Tells Primes: Stay in Own Back Yard," *Aviation Week* 62, no. 3 (17 January 1955): 13-15.
63. Livingston, "Weapon System Contracting," 86-88; Neufeld, *Ballistic Missiles*, 111, 113; and Johnson, *Culture of Innovation*, 65, 85-89.
64. For MIT's role in developing SAGE, see Thomas P. Hughes, *Rescuing Prometheus*, 15-67; Johnson, *Culture of Innovation*, 117-72; and Kent C. Redmond and Thomas M. Smith, *From*

Whirlwind to MITRE: The R&D Story of the SAGE Air Defense Computer.
65. E. E. Bauer, *Boeing in Peace and War*, 204-06.
66. Charles W. Colson and Murray Zweben, "An Analysis of Proposed Amendments to the Armed Services Procurement Act of 1947," *George Washington Law Review* 27, no. 4 (April 1959): 571; and Livingston, "Weapon System Contracting," 90-92.
67. Ltr, Lt. Gen. Elmer J. Rogers, Jr., Acting Chairman, Air Force Council, to Chief of Staff, USAF, 9 November 1959, sub: The Dyna-Soar Program, folder Air Force Council, box 25, White Papers, LC; and Bauer, *Boeing*, 209. In December 1963, Secretary of Defense Robert McNamara cancelled the Dyna-Soar program.
68. Claude Witze, "Speed R&D, USAF Orders Industry," and "Industry Hedges on New Policy," both in *Aviation Week* 63, no. 8 (22 August 1955): 12-13, 13-14; and Historical Division, Office of Information Services, Air Research and Development Command, United States Air Force, *History of the Air Research and Development Command, 1 January–30 June 1956*, Vol. I, *Narrative*, 210-21, 238, file K243.01, AFHRA.
69. William O. Miller, "AF Revises Contract Procedure," *Missiles and Rockets* 4, no. 4 (28 July 1958): 50; and Norman Waks, "Selective Competition in New Air Weapon Procurement," doctoral thesis, Graduate School of Business Administration, Harvard University, January 1961, chap. VI, 14. The open design competition also expended significant engineering and financial resources. The 13 airframe manufacturers that submitted a detailed design proposal for the XB–55 in 1948 spent an average of $750,000 each putting the bids together. See *History of the Air Research and Development Command, 1 January–30 June 1956*, Vol. I, *Narrative*, 196.
70. For this discussion of the source selection process, I have relied on Waks, "Selective Competition in New Air Weapon Procurement," chap. IV, 18-41. The Department of Defense granted Waks access to records and verified the accuracy of the procedures he described. See also Colopy, "Weapon Systems," 111-12; and "The WSPO Concept: Space Age Procurement," 15.
71. Precedents for the source selection process were established in the B–58 program in 1952 and in the ICBM program in early 1955 (see subsequent chapter sections).
72. The board's activities were supported by larger "working" and "evaluation" groups. In 1957, the board's membership expanded to include representatives of the using commands. For a detailed description of the formation of the Source Selection Board in the summer of 1955, see *History of the Air Research and Development Command, 1 January–30 June 1956*, Vol. I, *Narrative*, 196-256.
73. The board could also decide not to award a contract to any of the competitors.
74. Waks, "Selective Competition," chap. IV, 19. The first system to be acquired through the formal source selection process was the XB–70. See *History of the Air Research and Development Command, 1 January–30 June 1956*, Vol. I, *Narrative*, 241.
75. Waks, "Selective Competition," chap. IV, 38-41.
76. See Colopy, "Weapon Systems," 112-13; Richard Sweeney, "USAF Modernizes Flight Test Program," *Aviation Week* 69, no. 5 (4 August 1958): 84; and fig. 1 (Major Types of Air Force Test and Evaluation), in C. E. "Pete" Adolph, *A Career in Test and Evaluation: Reflections and Observations*, 10.
77. The Air Proving Ground Command had been established in 1942. Since it reported directly to the chief of staff, the Air Proving Ground Command enjoyed a degree of independence from the developing and using commands. See Lawrence R. Benson, *History of Air Force Operational Test and Evaluation (OT & E): Mission, Organization, and Policy*, 5-6.
78. Benson, *Operational Test and Evaluation*, 6-7; and Benson, *Acquisition Management in the United States Air Force and Its Predecessors*, 30.
79. Sweeney, "Flight Test Program," 84; Air Force Pamphlet no. 25-2-1, *Weapon System Management*, 30 June 1959, 29; and fig. 1, Adolph, *Test and Evaluation*, 10. Category I, accomplished initially by the contractor but followed closely by pilots from the Air Research and Development Command, consisted of the former Phases I, II, and III. Category II, performed mostly by the Air Research and Development Command but with some contractor

participation, encompassed the former phases IV, V, and VI. Category III, the former Phases VII and VIII, was carried out by the using command.

80. Lt. Gen. Roscoe C. Wilson, Deputy Chief of Staff, Development, Headquarters, USAF, "Methods for Generation of New Concepts and Opportunities for Reduction of Concept-to-Prototype Time Cycle," remarks before Defense Science Board, Offices of RAND Corporation, Santa Monica, Calif., 11 September 1958, 5, copy attached as tab E, item 5, Minutes of the Ninth Meeting of the Defense Science Board, 10-11 September 1958, box 834, Subject Files (Research and Development, 1953–1960), OSD/HO.

81. Ibid. Others believed that earlier participation by the user would not necessarily ensure an objective evaluation of new systems. In January 1974, under outside pressure, the Air Force reluctantly re-established an independent operational test agency, the Air Force Test and Evaluation Center, at Kirtland Air Force Base, New Mexico, that would report directly to the chief of staff. See Benson, *Operational Test and Evaluation*, 9-11.

82. See chaps. 5 and 6. For the F–84F, see Knaack, *Post–World War II Fighters*, 38-44.

83. The slow buildup idea was neither new nor original with Generals Cook and Craigie. Recall from chap. 5 that in January 1950 Lt. Gen. Ennis C. Whitehead, the commander of Continental Air Command, had suggested something similar to Lt. Gen. K. B. Wolfe, the deputy chief of staff for materiel. It had also been recommended in the Combat Ready Aircraft study of April 1951, prepared in the Office of the Deputy Chief of Staff for Development by then Col. Bernard A. Schriever. In October 1952, General Vandenberg, the chief of staff, directed that it be used in future acquisition programs.

84. Memo, Gen. Nathan F. Twining, Vice Chief of Staff, for All Deputy Chiefs of Staff, Inspector General, Assistant Deputy Chiefs of Staff, Directors and Chiefs of Comparable Offices, 16 February 1953, sub: Re-examination of Military Requirements, folder Air Force Council, 1953, box 60, Twining Papers, LC; Knaack, *Post–World War II Fighters*, 136-37; and Brown, *Flying Blind*, 176-77.

85. Knaack, *Post–World War II Fighters*, 177, 209; and Knaack, *Post–World War II Bombers*, 365.

86. Subcommittee of the Committee on Appropriations, House of Representatives, *Hearings, Department of Defense and Related Independent Agencies, Appropriations for 1955*, 83d Cong., 2d sess., 16 February 1954, 344-45.

87. Semiannual Report of the Secretary of the Air Force, January 1, 1954, to June 30, 1954, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1954,* 285.

88. Herbert F. York, *Race to Oblivion: A Participant's View of the Arms Race*, 84.

89. George M. Watson, Jr., *The Office of the Secretary of the Air Force, 1947–1965*, 152, 154-56.

90. Trevor Gardner, "Must Our Air Force Be Second Best," *Look* 20, no. 9 (1 May 1956): 77-81; Gardner, "Our Guided Missile Crisis," *Look* 20, no. 10 (15 May 1956): 46, 48, 50-52; and Gardner, "But We Are Still Lagging: Reasons Why, What We Can Do About It," *Life* 43, no. 19 (4 November 1957): 30-33. See also Gardner, "How We Fell Behind in Guided Missiles," *Air Power Historian* 5, no. 1 (January 1958): 3-13.

91. Gardner, "Second Best," 81.

92. Ibid.

93. Draft statement for Sen. Leverett Saltonstall (R-Mass.), 15-17, atch to memo, Max Lehrer, Office, Assistant Secretary of Defense (Comptroller), for Robert T. Ross, Assistant Secretary of Defense (Legislative and Public Affairs), 30 April 1956, folder Symington Committee, box 38, Records, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO.

94. Memo, R. A. Schultz, Technical Director for Aircraft, Weapons Systems Division, Office of the Deputy for Operations, Wright Air Development Center, Air Research and Development Command, for E. J. Gujer, Chief, Development Operations, Office of the Deputy for Operations, Wright Air Development Center, 11 February 1953, sub: Effect of Weapons Systems Concept, file 168.7265-240, 1953, Demler Papers, AFHRA; Philip Klass, "AF Tries 'Weapons

System' Plan," *Aviation Week* 58, no. 25 (22 June 1953): 16; and report, *Convair's Role as Weapons Systems Manager*, Convair, Fort Worth Division, approved by J. T. Cosby, 24 July 1953, 4, 6, doc. no. 119, in Richard D. Thomas with Charles E. Brooks, *History of the Development of the B–58 Bomber*, Vol. V, *Documents,* 87-166 [hereafter Convair report].

95. Richard D. Thomas, *History of the Development of the B–58 Bomber*, Vol. I, 115.

96. The letter contracts to Convair and Boeing that began B–58 development went out in February 1951; the first B–58 wing (the 43d Bomb Wing) was not combat ready until August 1962. See Knaack, *Post–World War II Bombers*, 207-08, 385; and Jay Miller, *Convair B–58 Hustler: The World's First Supersonic Bomber*, 60.

97. Preparedness Investigating Subcommittee, Senate Committee on Armed Services, *Investigation of the Preparedness Program: Report, The B–58 Program*, 86th Cong., 2d sess., 1960, 24.

98. For analysis of the B–58 program, I am particularly indebted to two articles by R. Cargill Hall, "To Acquire Strategic Bombers: The Case of the B–58 Hustler," *Air University Review* 31, no. 6 (September–October 1980): 3-20, and "The B–58 Bomber: Requiem for a Welterweight," *Air University Review* 33, no. 1 (November–December 1981): 44-56; and Brown, *Flying Blind*, 161-92. Other important studies of the B–58 are Thomas, *Development of the B–58*, Vol. I; Richard D. Thomas with Charles E. Brooks, *History of the Development of the B–58 Bomber*, Vol. II, *Narrative*; Miller, *B–58 Hustler*; and Knaack, *Post–World War II Bombers*, 351-99.

99. Unless otherwise noted, all performance data comparisons between the B–58A (the only model produced) and the B–47 and the B–52 are to the B–47E and the B–52G, the principal production models of those two aircraft at the time the B–58 entered operational service. Aircraft data comes from tables for the B–47, B–52, and B–58 in Knaack, *Post–World War II Bombers*, 156-57, 292-93, 397-98.

100. See Knaack, *Post–World War II Bombers*, 156, 292.

101. Ibid., 156, 293.

102. Thomas, *Development of the B–58*, Vol. I, 191; Thomas and Brooks, *Development of the B–58*, Vol. II, 216; Hall, "Strategic Bombers," 14-15, 17; Knaack, *Post–World War II Bombers*, 352, 363-64; and Brown, *Flying Blind*, 184-85.

103. Thomas, *Development of the B–58*, Vol. I, 184. General Paul K. Carlton, who as a colonel commanded the first operational B–58 wing, recalled what the plane's range limitation meant in terms of war-plan execution from U.S. bases and tanker requirements: "We were able to strike targets with two refuelings, three in some cases, on the eastern periphery of Russia, Poland, in as deep as Moscow, and recover in Scandinavia. We were targeted but very shallow. . . . It took two tankers to fill us up." Paul K. Carlton, interview by R. Cargill Hall and Charles Dickens, U.S. Air Force Oral History Program, 23 September 1980, Scott Air Force Base, Ill., 2, file K239.0512-1277, AFHRA. In contrast to the B–58, two tankers could fuel three B–52s for considerably longer flights into the Soviet Union. See Thomas and Brooks, *Development of the B–58*, Vol. II, 221.

104. Don Schanche, "A Missile with Men in It," *Life* 42, no. 15 (15 April 1957): 202, 205; August C. Esenwein, "Weapon System Management and the B–58 Hustler," *Sperryscope* 14, no. 6 (Third Quarter 1957): 7.

105. Hall, "B–58 Bomber," 56.

106. Ibid., and Miller, *B–58 Hustler*, 54, 107-11.

107. For the evolution of the supersonic bomber concept between World War II and the Korean War, see Thomas, *Development of the B–58*, Vol. I, 1-90; Miller, *B–58 Hustler*, 7-20; and Brown, *Flying Blind*, 162-68.

108. Thomas, *Development of the B–58*, Vol. I, 91-93; and Brown, *Flying Blind*, 168-69.

109. Thomas, *Development of the B–58*, Vol. I, 94-95, 116; and Knaack, *Post–World War II Bombers*, 361. Of the four contractors contacted, only Douglas and Martin offered proposals. The Air Force had also required that the submissions be received by the end of March 1951.

110. Brown, *Flying Blind*, 172.

111. Schanche, "Missile with Men," 197. In another version of the tale, Brig. Gen. Guy M. Townsend, a test pilot in both the B–47 and B–52 programs who went to work for Boeing after he retired, claimed that the doggerel had been left in the conference room at Wright-Patterson Air Force Base where Convair had made its design presentation and was subsequently recovered by a member of Boeing's briefing team. See Guy M. Townsend, interview by James C. Hasdorff, U.S. Air Force Oral History Program, 12-13 July 1982, Everett, Wash., 103, file K239.0512-1341, AFHRA.
112. Thomas, *Development of the B–58*, Vol. I, 125-29; and Brown, *Flying Blind*, 172-73. For the evolution of the Convair and Boeing designs, see Miller, *B–58 Hustler*, 21-26.
113. Hall, "Strategic Bombers," 8; and Brown, *Flying Blind*, 167-68, 173-75, 186. Brown argues that the Air Force also decided to forego prototypes because it feared that the big military budgets prompted by the Korean War would shrink before B–58 production could begin.
114. Historical Branch, Office of Information Services, Air Materiel Command, United States Air Force, *History of the Air Materiel Command, 1 January–30 June 1953*, Vol. I, *Narrative*, January 1954, 188, microfilm roll K2005, AFHSO.
115. When Convair delivered the B–36 to the Strategic Air Command in 1948, no tugs then in service could tow the giant aircraft and no provision had been made to acquire a more powerful vehicle. See Colopy, "Weapon Systems," 108. For Convair's system integration responsibilities, see Convair report, 24 July 1953, 1, 3-6, 10-19; rpt, *B–58 Weapon System Information*, 11 February 1960, 4-5, 10-14, doc. no. 238, in Thomas and Brooks, *Development of the B–58*, Vol. VI, *Documents,* 167-267; Senate Preparedness Investigating Subcommittee report, 1960, 22; and Lt. Col. Loren P. Murray, Jr., "B–58 Program—Test Bed for Weapon System Management," Air War College thesis no. 1988, Air University, Maxwell Air Force Base, Ala., April 1961, 38-42. Copy in Air University Library.
116. "Weapon System Plan Spurs Development," 84.
117. Convair report, 24 July 1953, 1, 4.
118. Putt ltr to Commanding General, Wright Air Development Center, 8 December 1952.
119. Ibid., and Schultz memo for Gujer, 11 February 1953.
120. Putt ltr to Commanding General, Wright Air Development Center, 8 December 1952.
121. Schultz memo for Gujer, 11 February 1953; Klass, "AF Tries 'Weapons System' Plan," 17; *History of the Air Materiel Command, 1 January–30 June 1953*, Vol. I, *Narrative*, 191; "Weapon System Plan Spurs Development," 85; and Senate Preparedness Investigating Subcommittee report, 1960, 20-21.
122. The subsystems and their contractors (in parentheses) were bombing/navigation (Sperry), autopilot and power control linkage assembly (Eclipse Pioneer Division of Bendix Aviation), bomber recording (Melpar), active defense (Emerson Electric), passive defense (Sylvania), power supply (Federal Telephone and Radio), civil navigational aids (Bendix Radio Division of Bendix Aviation), communications (Magnavox), air conditioning (Hamilton-Standard Division of United Aircraft), military navigational aids (Motorola), indirect bomb damage assessment (Ultrasonics), alternators and constant speed drive (Westinghouse), spike positioning (Minneapolis-Honeywell), rendezvous beacon (Bendix Pacific), positioning indicating beacon (Bendix Pacific), and long-range communications (Hughes). See *B–58 Weapon System Information* report, 11 February 1960, 15-16. Other listings of B–58 subsystems include the landing gear (Menasco Manufacturing), the wheels and brakes of the main landing gear (Goodyear), and the tires (General). See Esenwein, "Weapon System Management," 8-9; and Senate Preparedness Investigating Subcommittee report, 1960, 21.
123. "Beer and Pretzels . . . CFAE and GFAE," interview of August C. Esenwein, Convair vice president and manager of Fort Worth Division, *American Aviation*, July 14, 1958, 20. In mid-1958, Convair alone was doing business with over 3,700 companies.
124. At the same time, Convair's B–58 workforce totaled 14,000, most employed at the company's 600-acre, 4.3 million square foot-facility at Fort Worth. See atch 3 (Economic Impact) to ltr, Gen. Curtis E. LeMay, Vice Chief of Staff and Chairman, Air Force Council, to

Chief of Staff, 9 August 1960, sub: B–58 Program Review, folder Air Force Council (2), box 36, White Papers, LC; and Senate Preparedness Investigating Subcommittee report, 1960, 29.
125. Not everyone agrees with this assumption. In an analysis of congressional voting patterns, one scholar found no correlation between military spending in individual congressional districts (including efforts to widely distribute subcontracts) and a legislator's inclination to vote for a particular program. See Kenneth Mayer, *The Political Economy of Defense Contracting* (New Haven: Yale University Press, 1991), 17-18, 33-35, 156-73.
126. ARDC paper, "What is the Weapons Systems Concept," atch to memo routing slip for General Power [Lt. Gen. Thomas S. Power, commander, ARDC] et al., 1 March 1955, file 168.7265, 1949–1955, Demler Papers, AFHRA; *B–58 Weapon System Information* report, 11 February 1960, 4-7; Senate Preparedness Investigating Subcommittee report, 1960, 25; and Murray, "B–58 Program," 52-55.
127. Jacob Neufeld, ed., *Reflections on Research and Development in the United States Air Force: An Interview with General Bernard A. Schriever and Generals Samuel C. Phillips, Robert T. Marsh, and James H. Doolittle, and Dr. Ivan A. Getting*. Interview conducted by Richard H. Kohn, 63.
128. Murray, "B–58 Program," 55-57 (quotation, 56). Murray was deputy AFPR at Convair's Fort Worth plant for two years while the B–58 was under development. See also *B–58 Weapon System Information* report, 11 February 1960, 7; and Senate Preparedness Investigating Subcommittee report, 1960, 27.
129. My discussion of defense contracting draws heavily on an unpublished paper by Dr. J. Ronald Fox, "Defense Acquisition Contracts," prepared for the Defense Acquisition History Project in March 2006. For a contemporary description of defense contract types employed in the 1950s, see E. Perkins McGuire, Assistant Secretary of Defense (Supply and Logistics), *Procurement Presentation* to the Procurement Subcommittee of the Senate Committee on Armed Services, 86th Cong., 2d sess., 8-9 February 1960, 22-27, copy in folder Procurement, 1953–1960, box 586, Subject File (Installations and Logistics, 1945–1960), OSD/HO.
130. Senate Procurement Subcommittee, *Procurement Presentation*, 24. The percentage of cost-reimbursement contracts tended to be higher in the Air Force. In FY 1958, for example, cost-reimbursement contracts accounted for over half of the Air Force's procurement dollars. See, Subcommittee of the Committee on Armed Services, Senate, *Hearings, Military Procurement*, 86th Cong., 1st sess., 1959, 193.
131. A major weapon system's contract history is often complex and extensive, involving a series of contracts each with amendments and supplements. In the case of the Air Force's contracts with Convair for the B–58, two study contracts (in 1946 and in 1949) preceded the five development and production contracts. The first of the latter was an outgrowth of the letter contract of February 1951 that initiated the design competition with Boeing. In February 1953, following the Air Force's selection of Convair's design in November 1952, a supplement to this letter contract contained clauses governing development and preparations for production. In December 1954, an amendment to the contract added a specific quantity of aircraft to be procured. The Air Force and Convair did not "definitize" this initial contract (reach agreement on all of its specific provisions) until December 1955. Four additional cost-plus-incentive fee contracts followed, all initiated by letter contracts that were supplemented and amended and finally definitized (in one case, 21 months) after the letter contract had been issued. The final contract was initiated in July 1960. See Senate Preparedness Investigating Subcommittee report, 1960, 23-25; L. E. Preston, *Contract Negotiations and Results in Aircraft Procurement: Case Studies of the B–52 and the B–58,* 69-96; and Knaack, *Post–World War II Bombers*, 353, 356-57, 366, 375, 380 (note 48), 383, 396.
132. Preston, *Contract Negotiations*, 13-14.
133. Ibid., 73-74.
134. Maj. Gen. William T. Thurman, "Procurement by the United States Air Force," address to the Industrial College of the Armed Forces," Fort Lesley J. McNair, Washington, D.C., 10 January 1958, 8, NDU Library.

135. Frederic M. Scherer, *The Weapons Acquisition Process: Economic Incentives*, 166-67. Although Scherer did not identify the contractor organization, sponsoring government agency, and weapons program in this study, in a personal communication to the author he subsequently confirmed that the anonymous references were to Convair, the Air Force, and the B–58 contracts.
136. Hall, "Strategic Bombers," 5, 16; and Brown, *Flying Blind*, 170-71.
137. Brown, *Flying Blind*, 173.
138. Ibid., 179-80.
139. Knaack, *Post–World War II Bombers*, 364-72; and Brown, *Flying Blind*, 181-82.
140. Thomas, *Development of the B–58*, Vol. I, 152.
141. Hall, "Strategic Bombers," 13, 16; and Knaack, *Post–World War II Bombers*, 370-74.
142. The complement of a B–58 wing was 36 aircraft. The B–58s in the wing would not include any of the 30 aircraft planned for testing.
143. Hall, "Strategic Bombers," 16-17.
144. Knaack, *Post–World War II Bombers*, 378-79.
145. Esenwein, "Beer and Pretzels," 21.
146. Brown, *Flying Blind*, 181.
147. Ltr, Maj. Gen. Charles W. Schott, Deputy Inspector General, Headquarters, USAF, to Headquarters, SAC, 22 March 1960, sub: Survey of B–58 Weapon System, doc. no. 265, in Thomas and Brooks, *Development of the B–58*, Vol. VI, *Documents,* 167-267 [hereafter USAF IG report, March 1960]. See also Paul D. Foote [assistant secretary of defense, research and engineering], "Research Management in the Department of Defense," 3 September 1958, 7, tab F, item 5, Minutes of the Ninth Meeting of the Defense Science Board, 10-11 September 1958, box 834, Subject Files (Research and Development, 1953–1960), OSD/HO; and Knaack, *Post–World War II Bombers*, 379, 385, 388.
148. Knaack, *Post–World War II Bombers*, 390.
149. The comparable figures were $1.9 million for the B–47E and $7.7 million for the B–52G. See ibid., 142, 281, 391 (note 62), 392.
150. Hall, "B–58 Bomber," 53-54, 56. The average maintenance cost per flying hour for the B–47E was $361; for the B–52G, $1,025; and for the B–58, $1,440. See Knaack, *Post–World War II Bombers*, 142, 281, 392.
151. Hall, "B–58 Bomber," 53.
152. USAF IG report, March 1960, 9-10; Hall, "B–58 Bomber," 54, 56; and Knaack, *Post–World War II Bombers*, 353. The U–2 could fly at 70,000 ft., and the Soviets possessed a surface-to-air missile able to reach that altitude. See Watson, *Into the Missile Age*, 719. The B–58's combat ceiling was 63,080 ft., the B–52G's combat ceiling, 46,000 ft., and the B–47E's combat ceiling, 39,300 ft. See Knaack, *Postwar Bombers*, 398, 293, 156.
153. John C. Lonnquest outlines the various explanations offered for the success of the ICBM program in his doctoral dissertation "The Face of Atlas: General Bernard Schriever and the Development of the Atlas Intercontinental Ballistic Missile, 1953–1960," Ph.D. diss., Duke University, 1996, 1-6. In addition to Lonnquest's dissertation, the best studies of the ballistic missile program, all written from different perspectives, are, in order of their publication: Edmund Beard, *Developing the ICBM: A Study in Bureaucratic Politics*; Jacob Neufeld, *Ballistic Missiles in the United States Air Force, 1945–1960*; Thomas P. Hughes, "Managing a Military-Industrial Complex: Atlas," chap. 3 in *Rescuing Prometheus*; Stephen B. Johnson, *The United States Air Force and the Culture of Innovation, 1945–1965*; and Neil Sheehan, *A Fiery Peace in a Cold War: Bernard Schriever and the Ultimate Weapon*.
154. For the evolution of ballistic missile development in the Air Force from 1945 to 1953, see Neufeld, *Ballistic Missiles*, 25-92; and Lonnquest, "Face of Atlas," 1-40.
155. For the campaign to accelerate the program, see Neufeld, *Ballistic Missiles*, 93-107; Lonnquest, "Face of Atlas," 56-105; and Sheehan, *Fiery Peace*, 177-200, 207-24.
156. Lonnquest. "Face of Atlas," 176.

157. Neufeld, *Ballistic Missiles*, 108; and Lonnquest, "Face of Atlas," 116.
158. Neufeld, *Interview with General Bernard A. Schriever and Generals Samuel C. Phillips, Robert T. Marsh, and James H. Doolittle, and Dr. Ivan A. Getting*, 55.
159. Neufeld, *Ballistic Missiles*, 109-10; and Lonnquest, "Face of Atlas," 117-19.
160. Neufeld, *Ballistic Missiles*, 98-99; Lonnquest, "Face of Atlas," 92-94; and Sheehan, *Fiery Peace*, 233.
161. Neufeld, *Ballistic Missiles*, 111; Lonnquest, "Face of Atlas," 127-36; and Sheehan, *Fiery Peace*, 215-17, 233-35, 253-60. Sheehan accuses Convair's leadership, including its president, retired Air Force General Joseph McNarney, of using intimidation tactics and of being greedy and corrupt in resisting loss of the Atlas program's system integrator role.
162. Quoted in Lonnquest, "Face of Atlas," 116, 174.
163. Lonnquest, "Face of Atlas," 117.
164. Neufeld, *Ballistic Missiles*, 115-16, 138-39; and Lonnquest, "Face of Atlas," 177-79.
165. The best account of the ICBM proponents' campaign for outside support is Sheehan, *Fiery Peace*, 268-78, 287-99. But also see Lonnquest "Face of Atlas," 179-91.
166. Quoted in Leighton, *New Look*, 437.
167. Hyde Gillette, deputy for budget and program management, Office of the Assistant Secretary of the Air Force (Financial Management). A copy of the Gillette committee report, "Air Force Plan (Revised) for Simplifying Administrative Procedures for the ICBM and IRBM Programs," is included as app. 2 to Neufeld, *Ballistic Missiles*, 269-321.
168. Neufeld, *Ballistic Missiles*, 136.
169. House Committee on Government Operations Eleventh Report, *Organization and Management of Missile Programs*, 86th Cong., 1st sess., 2 September 1959, Committee Print 1121, 23-24; and Neufeld, *Ballistic Missiles*, 136-37. See also chap. 8 in this volume in the acquisition history series.
170. House Committee, *Missile Programs*, 24-25; and Putnam, *System Acquisition Management*, 9.
171. The Strategic Air Command agreed to assist the Air Research and Development Command and Schriever in achieving the IOC by formulating the operational concept for the ICBM and by establishing the first bases. When the Air Force decided that the Atlas missile was combat ready, then SAC would take over command and control of the system. See Neufeld, *Ballistic Missiles*, 121, 137-43, 152; and Lonnquest, "Face of Atlas," 176-77.
172. See chap. 8 in this volume in the acquisition history series; Leighton, *New Look*, 437-45; and Watson, *Missile Age*, 161-65. In March 1956, the Air Force assigned the initial operational capability for Thor to the Air Research and Development Command (i.e., Schriever and the Western Development Division). Later the Air Force divided responsibility for the IOC between ARDC and SAC. The initial IOC (10 missiles) was scheduled for October 1958 and the full IOC by July 1959. See Neufeld, *Ballistic Missiles*, 150.
173. House Committee, *Missile Programs*, 88-89; Neufeld, *Ballistic Missiles*, 119; and Lonnquest, "Face of Atlas," 137.
174. Maj. Gen. Bernard A. Schriever, "The USAF Ballistic Missile Program," *Air University Quarterly Review* 9, no. 3 (Summer 1957): 11-12. Ramo-Wooldridge assisted in subcontractor selection by evaluating the technical adequacy of the subcontractors' proposals. Apparently, however, company representatives were not present when the source selection board made the actual selections. Ramo-Wooldridge's presence on those occasions would have been a violation of policy requiring that only government officials make such decisions. See Irwin Stambler, "Scientific Management of Ballistic Missile Systems," *Aviation Age* 29, no. 4 (April 1958): 19; and Johnson, *Culture of Innovation*, 68, 79, 112 (note 17).
175. For the Manhattan Project, see Richard Rhodes, *The Making of the Atomic Bomb*, and Richard G. Hewlett and Oscar E. Anderson, Jr., *A History of the United States Atomic Energy Commission*, Vol. I, *The New World, 1939/1946*. For a shorter, but also authoritative account, see F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb*.

176. For parallel development in the Navy's nuclear submarine program, see Richard G. Hewlett and Francis Duncan, *Nuclear Navy, 1946–1962*; Francis Duncan, *Rickover and the Nuclear Navy: The Discipline of Technology*; and Gary E. Weir, *Forged in War: The Naval Industrial Complex and American Submarine Construction, 1940–1961.*
177. John Greenwood, "The Air Force Ballistic Missile and Space Program (1954–1974)," *Aerospace Historian* 21, no. 4 (December 1974): 193-94; and Neufeld, *Ballistic Missiles*, 119, 122-23, 132.
178. The Atlas configuration is described as a "stage-and-a-half" because the two booster and single sustainer rocket engines all ignited at liftoff, but the sustainer engine continued to burn after the booster engines had completed firing and dropped away. The structural integrity of Atlas' thin stainless steel skin was maintained by internal pressure from the contents of its fuel tanks. In contrast, Titan's fuselage, like that of an aircraft, was rigid. See Lonnquest and Winkler, *Defend and Deter*, 210-11, 230-31; and Lonnquest, "Face of Atlas," 141-42, 215-16.
179. The principal associate contractors for Thor were Douglas Aircraft (airframe and subsystem assembly), Bell Telephone and AC Sparkplug (guidance), propulsion (North American), and nose cone (General Electric). Thor made its first test flight in January 1957, only 13 months after Douglas Aircraft had received the airframe and subsystem assembly contract. In June 1959, the first Thor squadron, the 77th Royal Air Force Strategic Missile Squadron, went on alert in Great Britain. See Lonnquest and Winkler, *Defend and Deter*, 49, 268-69, 271-73; and Neufeld, *Ballistic Missiles*, 148.
180. Maj. Gen. Bernard A. Schriever, "AFBMD: Catching Up With the Soviets," *Missiles and Rockets* 4, no. 4 (28 July 1958): 53.
181. Maj. Gen. Bernard A. Schriever, "The USAF Ballistic Missile Program," in *The United States Air Force Report on the Ballistic Missile: Its Technology, Logistics, and Strategy*, ed. Lt. Col. Kenneth F. Gantz, 31. The best discussion of concurrency as applied by Schriever in the ballistic missile program is Lonnquest, "Face of Atlas," 161-75, 233-49. The Western Development Division did not formulate employment concepts for the missiles. That responsibility belonged to SAC, the using command.
182. Schriever, "Catching Up With the Soviets," 53; and John F. Loosbrock, "The USAF Ballistic Missile Program," *Air Force Magazine* 41, no. 3 (March 1958): 86. In 1958, more than 4,600 military and civilian personnel worked at the Inglewood complex, including almost 3,000 Ramo-Wooldridge employees. See Lonnquest and Winkler, *Defend and Deter*, 307.
183. For the Western Development Division's "Management Control System," see Irwin Stambler, "How BMD Directs AF's Ballistic Missile Programs," *Aviation Age* 29, no. 5 (May 1958): 18-19, 184-86; and Lonnquest, "Face of Atlas," 163-64, 227-32.
184. Lonnquest, "Face of Atlas," 284.
185. After Sputnik in the fall of 1957, financial support increased in an attempt to accelerate the missile program. See Neufeld, *Ballistic Missiles*, 150-51, 165-76, 242.
186. Glasser interview, 58.
187. Lonnquest, "Face of Atlas," 244.
188. Ibid., 204-05.
189. Schriever interview 1973, 16. With radio-inertial guidance, ground-based radars signaled course corrections to the missile. In an all-inertial system, gyros and accelerometers on board the missile adjusted its flight path. Radio-inertial guidance had two important limitations. In a radio-inertial system, missile launch positions had to be located close to a central guidance facility, increasing the system's vulnerability to attack or accident. Also, radio-inertial systems could launch only one missile every fifteen minutes, precluding salvo fire. The Atlas D used radio-inertial guidance. Its follow-on, Atlas E, was equipped with an all-inertial system. See Lonnquest, "Face of Atlas," 25-26, 26 (note 49), 213-14, 266-67.
190. In an interview given after he retired from the Air Force, Schriever contended that "we did the missile programs at a lot less cost under the concurrency management approach than if it had been done by the so-called fly-before-you buy [method]." See Schriever interview 1973, 11.

In 1986, in a written report on the Defense acquisition process to the President's Blue Ribbon Committee on Defense Management (the Packard Commission, named for its chairman David Packard, former deputy secretary of defense [January 1969–December 1971]), Schriever wrote: "A management concept of concurrency applied to the Intercontinental Ballistic Missile (ICBM) and Submarine Launched Ballistic Missile (SLBM) programs during the 50's and early 60's was highly successful in compressing time and reducing costs." See "Report on the Defense Acquisition Process," atch 2 to ltr, Gen. Bernard A. Schriever, USAF (Ret.), to David Packard, Chairman, President's Blue Ribbon Committee on Defense Management, 11 February 1986, 10, folder 400.13, box 60, Records of the Secretary and Deputy Secretary of Defense, 1992, Accession 330-95-0014, RG 330, Washington National Records Center, National Archives and Records Administration, Suitland, Md.

191. Lonnquest, "Face of Atlas," 101.

192. Neufeld, *Ballistic Missiles*, 185.

193. Lonnquest, "Face of Atlas," 245. Lonnquest believes that concurrency increased costs, but he also notes that apparently only a small number of the missile program's financial records have survived, making "a purely financial evaluation of concurrency impossible."

194. Ltr, Gen. Thomas S. Power, Commander in Chief, Strategic Air Command, to Gen. Thomas D. White, Chief of Staff, 6 October 1960, folder Missiles, Space, Nuclear, box 36, White Papers, LC.

195. Neufeld, *Ballistic Missiles*, 215-19, 231; Johnson, *Culture of Innovation*, 89-94; and Stephen B. Johnson, "Bernard Schriever and the Scientific Vision," *Air Power History* 49, no. 1 (Spring 2002): 38.

196. Johnson, *Culture of Innovation*, 96. Early in 1958, the Ballistic Missile Division had received authorization to begin work on the Minuteman.

197. Johnson, *Culture of Innovation*, 94-102. Schriever came to see configuration management as "absolutely essential and perhaps the most important element of an acquisition process." Schriever interview, 1973, 33.

198. Air Force Regulation 375-1 (Weapon/Support System Management), 31 August 1960.

199. Air Force Regulation 375-2 (System Program Office), 31 August 1960; and Air Force Regulation 375-3, 31 August 1960.

200. Quoted material is taken from the 23 January 1961 revision to Air Force Regulation 375-3.

201. Air Force Regulation 375-4 (Reliability Program for Weapon, Support, and Command and Control Systems), 5 October 1960. A revision to AFR 375-4 on 17 October 1960 changed its designation to AFR 375-5. On 4 June 1962, the reliability program became part of the Air Force's 80 series regulations (Research and Development) as AFR 80-5. In the meantime, on 20 January 1961, AFR 375-4 was republished with the title "System Program Documentation." This regulation specified the documentation required in a system program, including the contents of the "System Package Program."

202. Ltr, Gen. Curtis E. LeMay, Vice Chief of Staff and Chairman, Air Force Council, to Chief of Staff, 5 October 1960, folder Air Force Council (2), box 36, White Papers, LC; and text of flip chart briefing [Air Force Concept of Systems Management], 21 November 1960, folder T-9.28, file 168.7265-206, 1960–1961, Demler Papers, AFHRA.

203. The systems identified for package program management were Atlas, Titan, and Minuteman; several space programs (the MIDAS and Samos satellites, a space-based anti-satellite/anti-missile system, the space-based Saint satellite inspection system, and Dyna-Soar); the B–70 strategic bomber; the Skybolt air-to-ground missile (GAM–87); the F–105 fighter-bomber; a tactical aircraft warning and control system (412L); and the automated, command and control communications system (465L) designed to link Strategic Air Command headquarters with its operational forces. See ltr, Gen. Curtis E. LeMay, Vice Chief of Staff and Chairman, Air Force Council, to Chief of Staff, 26 October 1960, sub: Proposed Systems Under AFR 375-1, folder Air Force Council (2), box 36, White Papers, LC.

204. Lonnquest, "Face of Atlas," 275-76; Johnson, *Culture of Innovation*, 201; and Johnson, "Schriever and the Scientific Vision," 40.
205. Johnson, *Culture of Innovation*, 60.

I. Sources: Jacob Neufeld, "Bernard A. Schriever: Challenging the Unknown," in John L. Frisbee ed., *Makers of the United States Air Force*, 281-306; John C. Lonnquest, "The Face of Atlas: General Bernard Schriever and the Development of the Atlas Intercontinental Ballistic Missile, 1953–1960," Ph.D. diss., Duke University, 1996, 48-55, 167-72, 223-26; Stephen B. Johnson, "Bernard Schriever and the Scientific Vision," *Air Power History* 49, no. 1 (Spring 2002): 30-43; Jacob Neufeld, "General Bernard A. Schriever: Technological Visionary," *Air Power History* 51, no. 1 (Spring 2004): 38-43; and Neil Sheehan, *A Fiery Peace in a Cold War: Bernard Schriever and the Ultimate Weapon*, passim, but esp. xvii-xix.

CHAPTER X

Toward Centralization and the Systems Approach: The Navy and Acquisition, 1953–1960

On 20 July 1960, a Polaris missile, propelled by compressed air, broke through the ocean surface about 30 miles off Cape Canaveral, Florida, and with the ignition of its solid-fuel rocket motors, shot skyward. The 15-ton, 28-foot long, intermediate range ballistic missile, with a range of 1,200 nm, had been launched from *George Washington*, a nuclear-powered submarine.[1] Presidential candidate John F. Kennedy, who witnessed the event, remarked that "It is still incredible to me that a missile can be successfully and accurately fired from beneath the sea."[2] In mid-November, shortly after Kennedy's election, *George Washington* departed Charleston, South Carolina, on an operational patrol with 16 nuclear-tipped Polaris missiles stowed in 8 pairs of vertical launching tubes in a 130-foot-long compartment, about one-third of the submarine's length.[3]

The introduction of the Navy's Fleet Ballistic Missile system, usually called the Polaris system—a combination of missile (the Polaris), submarine launch platform, and support elements—gave the United States a triad of long-range bombers and land and sea-based ballistic missiles that would constitute a virtually invulnerable strategic deterrent for decades to come. Operational status for the new system was achieved in record time—less than four years after the chief of naval operations issued the formal requirement in 1957.[4]

But rather than marking a triumph of the Navy's decentralized acquisition structure, the Polaris system was a testament to its weaknesses. The program was carried out by the Special Projects Office, a nearly autonomous organization set up by the secretary of the Navy in late 1955 because he lacked confidence that the material bureaus, plagued by perennial jurisdictional disputes, could rapidly develop a sea-based ballistic missile system cutting across established institutional boundaries. Even so, Navy leaders viewed the Special Projects Office as a temporary measure to meet the high-priority requirement for a sea-based ballistic missile. Most believed that with some adjustments, the bureau system could still be responsive to the Navy's need for the timely development of complex weapons.

First Polaris missile fired from USS *George Washington* (SSBN–598), 20 July 1960.

After an overview of the Navy during the Eisenhower years, this chapter describes the evolution of the service's acquisition organization and management, marked during this period by tension between a trend toward greater centralization and the desire of many to maintain the traditional decentralized framework. In managing the Polaris program, the Special Projects Office employed much of the methodology characterizing the weapon system concept that the Air Force had begun to develop in the early 1950s—central planning and direction, a vertical, project-type organization, and concurrency.[5] By the mid-1960s, this acquisition pattern became standard in major Navy weapons programs. But during the 1950s, progress in this direction occurred slowly. Following the discussion of the Navy's acquisition structure, the chapter focuses on the steps taken toward adoption of the systems approach in the Bureau of Aeronautics.

THE NAVY IN THE EISENHOWER YEARS

Between the Korean War and the end of the Eisenhower administration, the Navy skillfully exploited advanced technologies to transform itself into a powerful nuclear and missile force. Applications of nuclear energy increased the destructive power and versatility of many of its weapons and made possible a revolutionary means of propulsion for naval vessels. Missiles either replaced or relegated to a secondary role guns and gravity-controlled bombs, providing ways, in addition to carrier-based aircraft, for the Navy to deliver nuclear weapons against the Soviet Union.[6] By 1960, the combination of nuclear and missile technologies in the Polaris system would secure for the Navy a unique place in the nation's strategic deterrent posture. Along with developing strategic delivery systems, the Navy applied nuclear, missile, and other advanced technologies to create a nuclear-powered subsurface and surface fleet and to modernize fleet air defense. In no small part, the Navy's aggressive pursuit of advanced weapon systems reflected the commitment of Admiral Arleigh A. Burke, chief of naval operations during most of Eisenhower's two terms.

NAVY/MARINE CORPS ACTIVE FORCES
FY 1954–FY 1961

FY	1954	1955	1956	1957	1958	1959	1960	1961
Major Combatant Vessels	405	402	404	409	396	386	376	375
Attack Carriers	14	15	15	14	14	14	14	14
Marine Divisions/ Wings	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3
Personnel [1,2]	950	866	871	877	829	802	788	803

1. Personnel figures (in thousands).
2. Includes Marine Corps personnel.

Development of Strategic Nuclear Delivery Capabilities

The Navy's performance during the Korean War did much to re-establish its prestige, but it was still overshadowed by the Air Force, largely because the latter was primarily responsible for strategic warfare. Throughout the 1950s, Navy leaders were determined to challenge the Air Force in this arena by developing credible strategic nuclear weapons delivery capabilities. Centered on massive retaliation, the Eisenhower administration's New Look policy was a powerful impetus toward this end. Although Admiral Robert B. Carney, chief of naval operations from 1953 to 1955, had reservations about relying on massive retaliation (and on the Air Force), and Admiral Burke, his successor, eventually turned against the doctrine during the latter part of his tenure, both went along with the New Look and sought to develop strategic nuclear systems because they represented assured funding and status for the Navy.[7] In his annual report for 1955, Secretary of the Navy Charles S. Thomas asserted that in the Navy, "the greatest [offensive] emphasis has been placed on increasing atomic weapons delivery potential."[8]

During the 1950s, the Navy developed a three-pronged strategic nuclear delivery capability: aircraft launched from heavy attack carriers, cruise missiles launched from surface ships, and ballistic missiles launched from below the surface by nuclear-powered submarines.[9] It also produced many other nuclear-armed weapon systems, including air-to-air, air-to-surface, and antiaircraft guided missiles as well as antisubmarine bombs, rockets, and torpedoes. These nuclear capabilities helped the Navy to maintain a share of the post–Korean War Defense Department budget that was not nearly as large as the Air Force's but was substantially more than the Army's. From FY 1955 (the first non-Korean War budget year) through FY 1961, the Navy averaged almost 30 percent of the annual military budget, and the Army and Air Force just over 23 percent and 44 percent, respectively.[10]

As described in chapter 7, the Navy had established a minimal strategic nuclear delivery capability by the end of the Korean War. Both the P2V–3C Neptune, a long-range patrol aircraft with two piston engines that had been modified to carry an atomic bomb, and the AJ–1 Savage, powered by a turbojet and two piston engines, could take off from the Navy's three *Midway*-class carriers. Still, neither aircraft was well-suited to conduct strategic nuclear strikes: both were relatively slow and their weights and sizes made operating from the carriers then in commission difficult (in fact, the Neptune was too big to land on even the large *Midway*-class carriers).

In 1954, the launching of the 60,000-ton *Forrestal*, the first of a new class of heavy attack carriers, enabled the Navy to accommodate increasingly high-performance jet aircraft, including heavy attack bombers such as the A3D Skywarrior, operational in 1956, and its unsuccessful supersonic follow-on, Rockwell's A–5 (originally A3J) Vigilante, which began to enter fleet service in 1960. Before Eisenhower left office, the Navy launched five more ships in the *Forrestal* class: *Saratoga* (1955), *Ranger* (1956), *Independence* (1958), *Kitty Hawk* (1960), and *Constellation* (1960). In 1960, the service's first nuclear-powered aircraft carrier, *Enterprise*, slid down the building ways at the Newport News shipyard.[11] The construction of the *Forrestal*-class carriers, combined with the introduction of the A3D Skywarrior, gave the Navy a credible, carrier-based strategic nuclear delivery capability.

Surface-to-surface cruise missiles constituted the second element in the Navy's strategic attack arsenal. At the end of the Korean War, two such missiles, Rigel and Regulus, then under development, competed for the land attack mission. The Navy chose the latter. Regulus, a subsonic (Mach .9), turbojet-propelled missile about the size of a small jet aircraft, could be fired from surface ships to a distance of 500 nm. In late 1954, it became the Navy's first operational missile of any type (see chap. 7).

Submarines, cruisers, and aircraft carriers served as launch platforms for Regulus. The initial deployment was to a submarine, the converted diesel-electric fleet boat, *Tunny*, in 1954. Four other submarines followed. One was another diesel-electric conversion, *Barbero*. Two more diesels, *Grayback* and *Growler*, both originally intended to be fast-attack submarines, were modified during construction to carry Regulus. The nuclear-powered *Halibut* was the only submarine designed from the start to be Regulus-equipped. In February 1955, the heavy cruiser *Los Angeles* began a deployment to the Western Pacific with 3 nuclear-armed Regulus missiles. By 1957, 3 other cruisers in the same class, *Helena*, *Toledo*, and *Macon*, as well as 10 *Essex*-class aircraft carriers could fire the missile.[12]

Heavy cruiser USS *Los Angeles* (CA–135) firing a Regulus I surface-to-surface missile, August 1957. Courtesy, Naval History and Heritage Command.

Regulus possessed some advantages over carrier-based heavy attack aircraft. It was cheaper and did not put pilots in harm's way.[13] But the missile had several drawbacks. Its range was significantly inferior to the combat radius of heavy attack aircraft, such as the A3D, that could carry a nuclear weapon to targets beyond 1,500 nm; its radio guidance system was undependable and inaccurate; and it could not be recalled or reused.[14] A follow-on system, Regulus II, promised to correct some of Regulus I's disadvantages. Under development since the summer of 1953, Regulus II was supersonic (Mach 2), could range twice as far as Regulus I, and, with an inertial guidance system, was more accurate than its predecessor.[15] But, straining to fund the expensive Polaris system, the Navy cancelled Regulus II in December 1958.[16]

The Navy's third strategic nuclear delivery capability, the Polaris system, rapidly eclipsed in importance both long-range, carrier-based aircraft and cruise missiles. It brought together several advanced technologies—nuclear propulsion, an improved solid-fuel missile propellant, lighter and smaller thermonuclear warheads, a compact inertial guidance system for the missile, and an inertial navigation system for the submarine. In early 1957, however, when the chief of naval operations called for a 1,500 nm, solid-propellant, nuclear-tipped missile that could be launched from a submerged submarine and would be operational by 1965, only one of those technologies, nuclear propulsion, had been developed sufficiently.[17] That the Special Projects Office, the program manager for the Polaris system, was able to deploy an operational system in less than four years from the time the requirement was issued demonstrated the Navy's skill at exploiting new technologies and the cumulative knowledge of U.S. missile development.

Nuclear propulsion for submarines had been a reality since early 1955. On 17 January, a signalman on board *Nautilus*, which departed the Electric Boat Company's pier at Groton, Connecticut, and was proceeding down the Thames River toward Long Island Sound, blinked "Under way on nuclear power" to an escort vessel.[18] The new means of propulsion significantly improved the submarine's capabilities, increasing its speed and enabling it to remain submerged and at sea for much longer periods than its diesel-electric predecessor. Other submarine technologies developed during the 1950s, including the teardrop-shaped hull, single-screw propeller, and higher-strength steels for hulls made submarines even more capable with respect to speed, maneuverability, and the depths to which they could dive.[19]

When combined with a nuclear-tipped ballistic missile, nuclear submarines would become formidable strategic weapons. But marrying a missile of any kind to a submerged submarine was a complex undertaking. Advanced technology provided solutions to such difficult problems as ejecting the missile from the boat while it was underwater, giving fire control directions to the missile, and enabling the submarine to determine its own location (essential for missile accuracy) and communicate with land stations while submerged.[20]

In late 1956, when Secretary of Defense Wilson permitted the Navy to terminate its participation with the Army in the liquid-fuel, Jupiter intermediate range ballistic missile program, the service turned its full attention to developing a solid-fuel IRBM. At that time, however, a solid propellant with sufficient thrust, a thermonuclear warhead of reduced size and weight, a compact inertial guidance system for the missile, and an inertial navigation system for the submarine—the key technologies besides nuclear propulsion essential for Polaris—were either immature or did not yet exist.

Because liquid-fuel propellants were both dangerous and difficult to handle at sea, the Navy had always preferred solid fuel for rockets and missiles. On the other hand, solid-fuel propellants did not provide as much thrust as liquid propellants. In mid-1956, Navy-sponsored research demonstrated that a solid fuel with greater thrust could be produced. Even so, it would not be enough to propel a missile with a 1,600-lb. nuclear warhead 1,500 nm, the performance expected of Jupiter. Another development, involving nuclear warheads and occurring at about the same time, promised to overcome this limitation. At a Navy-sponsored conference on antisubmarine warfare (Project Nobska) in the summer of 1956, Dr. Edward Teller, one of the nation's leading nuclear physicists, predicted that, given the trend toward reduced weight-to-yield ratios, a smaller and lighter thermonuclear warhead, with sufficient destructive power and suitable for missile launch from a submerged submarine, could be available by 1963. The Atomic Energy Commission supported Teller's estimate, indicating that a 600-lb. warhead with a yield comparable to that produced by the much heavier Jupiter warhead was indeed feasible. The likelihood of an improved solid propellant and more compact warhead were crucial factors in Secretary Wilson's decision to allow the Navy to drop out of the Jupiter project and focus solely on a solid-fuel missile.[21]

USS *Nautilus* (SSN–571) immediately after launching at Electric Boat Co. yard, Groton, Connecticut, 21 January 1954.

The required missile guidance and submarine navigation systems grew out of research on inertial technology conducted by MIT's Instrumentation Laboratory, under its director, Charles Stark Draper. Developed under contracts with the laboratory and with General Electric (for production), the Polaris missile's inertial guidance system built on work Draper and his associates had performed on the Air Force's Thor IRBM and Atlas ICBM programs. In 1954, the Instrumentation Laboratory, under contract to the Bureau of Ships, had delivered a prototype Ships Inertial Navigation System (SINS). The inertial navigation system evolved from a joint Instrumentation Laboratory/Sperry Corporation effort and a design developed independently by the Autonetics Division of North American Aviation, with the latter system eventually becoming standard in the first Polaris submarines.[22]

Before the end of Eisenhower's second term, Congress authorized 14 Polaris-equipped submarines in three classes. *George Washington*, which went on operational patrol with 16 Polaris missiles in November 1960, and 4 other boats in its class, had originally been designed as attack submarines and were altered to make room for the 130-ft. long missile compartment. The *Ethan Allen* class, also consisting of 5 submarines, was designed from the outset to carry ballistic missiles. Finally, the *Lafayette* class would eventually total 31 submarines. These boats, costing an average of $150 million each, gave the Navy what it had long sought—an unassailable role for itself in strategic deterrence.[23]

The Lure of a Nuclear Fleet

Nautilus' success stimulated widespread enthusiasm in the Navy for nuclear propulsion for both submarines and surface ships. In January 1958, Admiral Burke approved for service-wide distribution an internal study, "The Navy of the 1970 Era." It projected that, in a fleet of more than 900 ships, nuclear energy was to power 50 missile and 75 attack submarines, 6 carriers, 12 guided missile cruisers and 18 guided missile frigates. But nuclear vessels were expensive. While few questioned the value of nuclear-propelled submarines, others maintained that the high cost of nuclear surface ships, which offered relatively few advantages over those powered by conventional means, could not be justified.[24] By the time Eisenhower left office, except for submarines, the Navy had not made much progress toward realizing the ambitious goal of the nuclear fleet that Burke endorsed. Nor did it seem likely that it would.

As we have seen, nuclear propulsion was a crucial element in making possible the third leg of the nation's strategic deterrent. But the nuclear submarine's ability to go faster, dive deeper, maneuver more easily, and stay submerged and at sea longer, suited it well for other roles, especially antisubmarine warfare. In the 1950s, the Soviet surface and submarine fleets expanded significantly.[25] Following a 1955 Central Intelligence Agency estimate that the Soviets might be building as many as 100 attack submarines annually, Admiral Burke made antisubmarine warfare a top priority.[26] Beginning in 1958, it assumed even greater importance. That year the Soviets deployed their first nuclear-powered submarine.[27] In April, Rear Adm. W. A. Schoech, assistant chief for research and development in the Bureau of Aeronautics, informed a division directors' meeting that "ASW [antisubmarine warfare] is the No. 1 function of the Navy and every officer and civilian of the Bureau must constantly keep this in mind and act accordingly."[28] Fast-attack nuclear submarines became the Navy's principal means of countering the Soviet subsurface and surface threats. By 1960, 11 nuclear attack submarines had been commissioned and an additional 18 authorized.[29]

The Navy's plans for nuclear-powered surface ships did not fare as well. In 1958, the keel was laid for the nuclear carrier *Enterprise*. When commissioned in late 1961, the giant vessel was powered by 8 nuclear reactors, displaced nearly 90,000 tons fully loaded, and extended over 1,100 feet in length with a flight deck almost 250 feet in width.[30] But it cost approximately $455 million to build, more than double the $218 million price tag for the conventionally powered *Forrestal*.[31] By late 1959, *Enterprise's* enormous expense caused the Navy to reconsider acquiring a second nuclear carrier. In its shipbuilding program for FY 1960, the Navy asked for another conventionally powered carrier instead. Congress did not go along and appropriated $35 million for long-lead time subsystems for a second nuclear carrier. But the cost-conscious Eisenhower administration preferred a conventionally powered carrier and impounded the funds.[32] Not until 1968 would construction begin on the Navy's second nuclear carrier, *Nimitz*.[33] The high cost of two other nuclear-powered surface ships laid down in the 1950s, the guided missile cruiser *Long Beach*, commissioned in 1961, and the guided missile frigate *Bainbridge*, commissioned in 1962, further dampened the Navy's enthusiasm for an extensive nuclear-powered surface fleet.[34]

Technology and Fleet Air Defense

Throughout the 1950s, the carrier task force, with the heavy attack carrier at its center, was the Navy's principal striking arm for both nuclear and conventional operations. Soviet high-speed jet aircraft carrying air-launched missiles posed an increasing danger to the carriers. To detect and engage enemy aircraft as far out as possible, the Navy deployed airborne and seaborne radar pickets, improved fighter aircraft, and missile-armed surface escorts. The response of all elements of the task force to an airborne threat had to be rapid and highly coordinated. Advances in electronic technology provided the means to this end.

Well aware that its carrier-based fighters had not measured up to Soviet jets in the Korean War and concerned that this deficiency would threaten the survival of the big carriers, the Navy introduced several new types of high-performance fighter aircraft in the years following the war (see the final section in this chapter). Along with fighters, the Navy provided the fleet with more capable guns, but they were not effective against the long-range, high-altitude air threat.[35] Guided missiles promised to take up the slack. By the end of 1960, three surface-to-air missiles, all under development before the end of the Korean War, were put on board newly designated guided missile cruisers, frigates, and destroyers. Terrier, a supersonic, rocket-powered, radar beam rider with an initial range of 10 nm (later increased to 40 nm), was first installed on the heavy cruiser *Boston* in late 1955 and subsequently on the smaller guided missile ships. The large ramjet-driven Talos, also supersonic and a radar beam rider with a range of 50 to 100 nm, could be accommodated only on cruisers and frigates. Although scheduled for deployment in 1956, Talos was not fired at sea until 1959. The solid-fuel Tartar, equipped with "semiactive guidance" by which the missile homed in on radar energy that was emitted from the firing ship rather than from the missile itself, was designed to take on low-flying and high-speed aircraft at ranges of 10 to 20 nm. Relatively small in size (1,000 lbs. compared with the 2,400 lb. Terrier and 3,l00 lb. Talos), Tartar could be launched from destroyers. It first went to sea in 1960.[36]

Initially the Navy converted ships already in commission to carry the guided missiles. The first were two heavy cruisers—*Boston*, recommissioned in November 1955, and *Canberra* in June 1956. Nine more World War II–era cruiser conversions followed. Before the end of the decade, the Navy also received authorization for three classes of destroyers and frigates designed from the keel up as missile platforms. The first of these was funded in 1956. In December 1959, *Dewey*, a frigate in the *Farragut* class, became the first missile-only ship to be commissioned. By the end of Admiral Burke's tenure as chief of naval operations in 1961, the keels of 40 guided missile escorts had been laid.[37]

In the mid-1950s, the carrier task force did not lack for information regarding impending air threats. The large amounts of data furnished from a variety of sensors and sources—visual sighting, radar, electronic countermeasures equipment, and ships and planes—overwhelmed the task force's ability to process and employ it effectively in a rapid and coordinated response. During and after World War II, air threat indications from visual observation or radar had been marked with grease pencil on transparent plotting boards. These manual methods were far too slow for the jet and missile age. In the early 1950s, even the Navy's first electronic data-handling system employing analog technology fell well short of the capabilities required. What was needed was an automatic data processing system that could process, evaluate, display, and exchange information among all task force elements in real time. By 1961, the Naval Tactical Data System, based on the transistor and the high-speed digital computer, was well on the way toward meeting the requirement.[38]

Construction of the USS *Enterprise* (CVAN-65) nearing completion, Newport News, Virginia, April 1961.

Managed by a small project office in the Bureau of Ships, development of the Naval Tactical Data System began in the spring of 1956. System testing started at the Navy Electronics Laboratory near San Diego, California, in April 1959, with service testing following on the frigates *King* and *Mahan* and the *Essex*-class carrier *Oriskany* beginning in the fall of 1961. While service testing was taking place, the system was also installed on the nuclear-powered cruiser *Long Beach* and the carrier *Enterprise*. In March 1963, the chief of naval operations approved the Naval Tactical Data System for service-wide use.[39]

Burke's Influence

Arleigh Burke, chief of naval operations from 1955 to 1961, thoroughly appreciated the importance of scientific and technical progress in modern warfare and was determined to keep the Navy in the forefront of weapons technology. Both his educational background and several of his assignments oriented him naturally in this direction. When he graduated from the Naval Academy in 1923, like all midshipmen, he had received a technical education, heavily concentrated on engineering. Before World War II, he also spent 15 months studying ordnance at the Navy's Postgraduate School at Annapolis, and had earned a master of science degree in chemical engineering from the University of Michigan. Between 1945 and 1950, Burke served briefly after the end of the war as the director of research in the Bureau of Ordnance and, toward the end of the decade, as the senior Navy officer (Navy secretary) assigned to the staff of the Department of Defense's Research and Development Board.[40]

While chief of naval operations, Burke oversaw the acquisition of numerous advanced weapon systems. Polaris, of course, stands out in this regard. Other systems, either authorized or introduced into fleet service before he left his post, were guided missile cruisers, frigates, and destroyers; three nuclear-powered surface ships (*Enterprise*, *Long Beach*, and *Bainbridge*); two classes of nuclear attack submarines (*Skipjack* and *Thresher*); a variety of high- performance jet aircraft including the McDonnell F4H Phantom II (later F–4B) and the Grumman A2F Intruder (later A–6); a wide array of guided missiles (the Sparrow and Sidewinder air-to-air missiles; the Terrier, Talos, and Tartar surface-to-air missiles; and the Bullpup air-to-surface missile); the Naval Tactical Data System, and the modern, worldwide Naval Communications System.[41]

Admiral Arleigh A. Burke, chief of naval operations, 1955–1961.
Courtesy, Naval History and Heritage Command.

Leaders routinely receive credit for accomplishments of their organizations. But sometimes they have had little to do with, or have been indifferent to, or have even opposed the undertakings that led to those achievements. Such was not the case with Burke. He was directly and decisively involved in providing the Navy with the most advanced weapon systems. Within a week of becoming chief of naval operations in August 1955, Burke decided, despite strong internal opposition, that the Navy should actively pursue ballistic missiles. He was then instrumental in establishing, and continued to be an unflagging supporter of the Polaris program.[42] According to one of his biographers, Admiral Burke was "its motivator and to some extent its guide. He got the money for it. He promoted it at the secretary of defense level. He was continually behind it, goading, encouraging, financing, and defending it."[43] In September 1955, after conferring with Rear Adm. Hyman Rickover, director of the Navy's nuclear propulsion effort, regarding the FY 1956 shipbuilding program, Burke announced that future submarines would all be nuclear powered.[44] Then in October, certain that the Soviets would soon have their own nuclear-powered submarines, he initiated the mid-summer 1956 study of antisubmarine warfare known as Project Nobska.[45] Burke also took steps to modernize the surface fleet. Allied with Rickover, he pushed to apply nuclear power to surface vessels.[46] To redress what he considered serious deficiencies in fleet air defense, Burke sponsored the major conversion and new construction program that gave the Navy guided missile cruisers, frigates, and destroyers.[47] He then became a strong advocate of the Naval Tactical Data System.[48]

Burke's desire to deploy as rapidly as possible weapon systems that incorporated the most recent advances in warhead, missile, propulsion, and electronic technologies encountered significant obstacles. Along with the uncertainties inherent in their development, advanced systems were also enormously expensive. With the tight Eisenhower Defense Department budgets, not all could be afforded, sometimes forcing hard choices to be made among them. In addition to the scarcity of funds, many high-level Navy officials believed that deficiencies in the service's organization for acquisition, particularly rivalry among the technical bureaus, delayed delivery of the weapons needed by the fleet. When Burke became chief of naval operations, the conflict between the Bureau of Ordnance and the Bureau of Aeronautics in the guided missile field, under way since the end of World War II, was particularly intense. In fact, its apparent intractability was the major reason that Burke agreed with the secretary of the Navy that an entirely new organizational arrangement independent of the bureaus—the Special Projects Office—should develop a ballistic missile system.

Despite the establishment of the Special Projects Office, Burke continued to support the bureau system and believed it could be made to work effectively. He understood that the main problem was finding a way to integrate into a whole the interdependent elements of complex weapon systems whose subsystems were often developed by more than one bureau. Early in January 1956, not long after recommending creation of the Special Projects Office, Burke appointed a board to examine the bureau system of organization with respect to the development of naval weapon systems. In his instructions to the board, Burke emphasized the need to integrate weapon system elements.[49] Later in the year, in a letter to the deputy chiefs of naval operations and to the technical bureaus, he noted that a representative of a major Navy contractor had told him that the service "had not yet adopted the weapons systems concept, but instead was still fitting detailed components together into a weapons system, with nobody responsible for the effectiveness of the overall system." Burke declared that "it is essential that technical Bureaus working on the various components of a single weapons system collaborate with each other to the maximum extent . . . ."[50] But the bureaus failed to respond as expected, leading the Navy toward more centralized control over acquisition.

ACQUISITION ORGANIZATION AND MANAGEMENT

In October 1953, following enactment of Department of Defense Reorganization Plan No. 6, Secretary of the Navy Robert B. Anderson appointed a committee to study the Navy's organization. After more than six months' work, the committee, chaired by Under Secretary Thomas S. Gates, Jr., found it to be "basically sound." Concerning acquisition specifically, the Gates Committee recommended that the already vague coordinating authority of the chief of naval research for the service's research programs be broadened to encompass the "developmental phases of applied research and development." The committee also concluded that any difficulties in "procurement, production and contracting" were "procedural, rather than organizational in nature."[51] The Gates Committee, in effect, had endorsed the decentralized and fragmented acquisition structure embodied in the bureau system. Over the course of the 1950s, however, many Navy leaders became increasingly aware of its shortcomings, particularly regarding the integration of complex, advanced technology weapon systems. But rather than abolishing or fundamentally changing the bureaus, they chose to address their weaknesses with procedural and organizational adjustments. The changes did not significantly improve weapon system integration, but did move the Navy slowly away from its traditional decentralized acquisition organization toward a centralized structure directed by the secretariat and the Office of the Chief of Naval Operations, OPNAV.

The Bureaus and Missile Cognizance

Friction among the bureaus over control of entire categories of weapon systems, a particular system, or even subsystems was a persistent feature of Navy acquisition in the decade and a half after World War II. Sometimes these disputes were settled. During the Korean War, for example, the Bureau of Ships finally surrendered responsibility for airborne electronic equipment to the Bureau of Aeronautics.[52]

In mid-1955, after prolonged argument between the Bureau of Ordnance and the Bureau of Aeronautics, Admiral Carney, the chief of naval operations, had to step in, assigning responsibility for solid-propellant motors to the former and aircraft fire control systems to the latter.[53] But none of these conflicts lasted as long or approached the intensity of the battle between the Bureau of Ordnance and the Bureau of Aeronautics over guided missile programs. Top-level Navy officials, both uniformed and civilian, believed bureau rivalry over missiles was damaging the service.

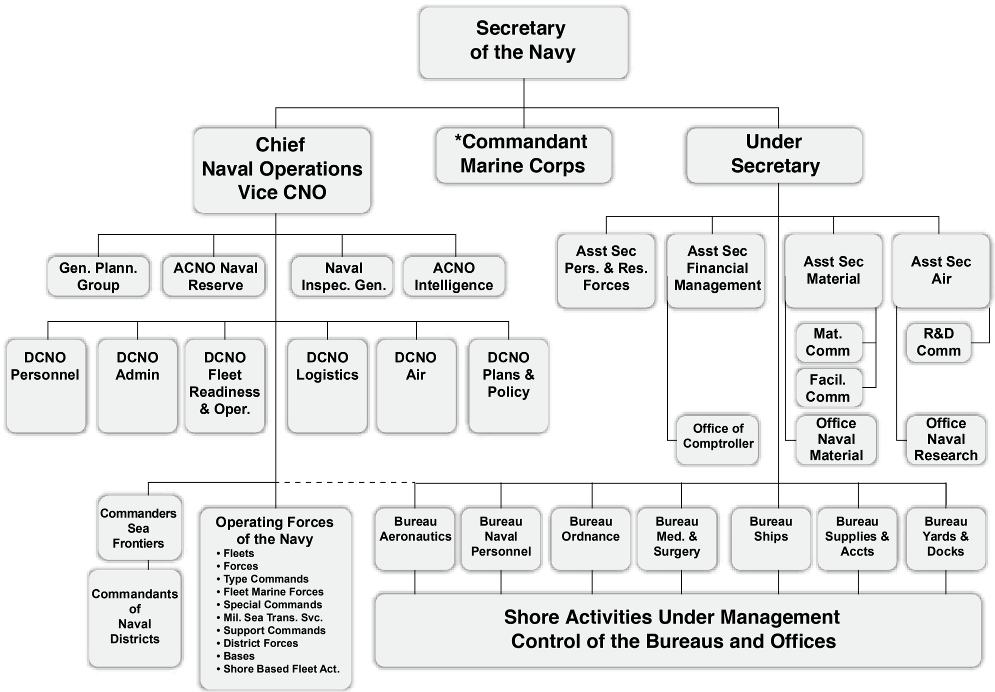
During this period, the Navy based the determination of cognizance for a missile system on a bureau's perceived capabilities rather than on the nature of the missile. This led to some assignment responsibilities that did not seem to make sense to many observers. The Bureau of Ordnance, for example, was developing the Sidewinder air-to-air missile and the Petrel air-to-surface missile while the Bureau of Aeronautics ran the ship-launched Regulus I and II programs. In mid-June 1955, in what seemed a logical move that might prevent further disputes over missile cognizance, Admiral Carney proposed that air-launched guided missiles should come under the Bureau of Aeronautics and surface-launched guided missiles should belong to the Bureau of Ordnance. However, Rear Adm. James S. Russell, chief of the Bureau of Aeronautics, objected, arguing that the suggested changes "do not recognize and use the already developed special abilities of these two bureaus, but rather make an arbitrary and sweeping division of tasks without regard for particular competence." The best solution, Russell stated, was to merge the two bureaus.[54]

The matter was unresolved when Admiral Burke replaced Carney as chief of naval operations in mid-August 1955. Moving quickly, Burke appointed an ad hoc committee composed of three high-ranking admirals in OPNAV to solve the problem. The committee recommended that in the future, the Bureau of Ordnance should be the "dominant" bureau for ship-launched missile programs and the Bureau of Aeronautics for air-launched missiles. The Bureau of Ships would be a full partner with the dominant bureau for missile programs that involved ships in any way. The proposed division of responsibility would not affect programs currently under way. Burke endorsed the committee's recommendations and, in early September, asked Secretary of the Navy Thomas to approve a letter he planned to send to the bureau chiefs announcing the new policy.[55] Thomas did not respond to Burke's request.

The secretary of the Navy's silence may have been due to the arguments presented by James H. Smith, Jr., the assistant secretary of the Navy for air. In a 6 October 1955 memorandum to Thomas, Smith called the proposal "somewhat expedient" and an indication that "the missions of the Bureaus do not fit into today's scheme of things" in which weapon system subsystems are interdependent and often common to more than one bureau. Smith thought the solution lay in reorganization, perhaps the creation of a "Weapons Systems Bureau."[56]

Writing to Thomas few days later, Burke, who had received a copy of the memorandum, disputed Smith's suggestion that reorganization would solve the missile cognizance problem, asserting that reorganization would be too disruptive and, in any case, was not needed because cooperation and coordination among

DEPARTMENT OF THE NAVY
1956



* Additional direct responsibility to the CNO for the readiness and performance of those elements of the operating forces of the Marine Corps assigned to the operating forces of the Navy.

Source: Adapted from Chart 12, Presentation of Rear Adm. T.C. Lonnquest before the Board to Study and Report upon the Adequacy of the Bureau System of Organziation, 14 February 1956, box 21, Op–00 Files (1956), OAB, NHC.

the bureaus had significantly improved in the last few months. He also told the secretary that all the bureau chiefs were satisfied with the proposed division of missile responsibility.[57]

In fact, however, the Bureau of Aeronautics considered the new missile cognizance policy to be a crushing blow. In a 12 October memorandum, Rear Admiral Russell implored Admiral Burke to recall the recommendation: "I believe your proposed action would deny BuAer, and to some extent naval aviation, a share in the weapon systems of the future. I beg you to withdraw from SecNav this proposition which is so damning to my bureau, and to continue the present system of CNOs assigning specific projects to particular bureaus."[58]

Although not explicitly addressed in the documents exchanged between the participants, the real stakes in the conflict were control of the Navy's nascent ballistic missile program. Officers in the Bureau of Aeronautics had been working on aspects of ballistic missile development since 1954. Early in 1955, their efforts received a boost when the Technological Capabilities Panel of the Office of Defense Mobilization's Science Advisory Committee, chaired by James Killian, emphasized the need for intermediate range ballistic missiles and recommended that both land and sea-based systems be considered (see chap. 8). In July 1955, Rear Admiral Russell established a formal development program. Almost immediately, then-CNO Admiral Carney, albeit reluctantly, directed the Bureau of Aeronautics to discontinue work that might expand ballistic missile research and development and lead to contracts and a budget commitment. But the directive was too late. The bureau had already sought the advice of more than 20 contractors, and Russell had enlisted the support of Assistant Secretary Smith.[59] In September, the National Security Council endorsed the Killian panel's recommendations. By this time, the high-level interest in sea-based intermediate range ballistic missiles had prompted the Bureau of Ordnance, even though previously expressing skepticism about the need for ballistic missiles, to contest their assignment to the Bureau of Aeronautics.[60]

Navy leaders had been convinced for some time that the long-lived struggle between the Bureau of Ordnance and the Bureau of Aeronautics over missiles had seriously harmed the service. The conflict was well known outside of the Navy, especially in the Office of the Secretary of Defense and Congress. Rear Adm. John H. ("Savvy") Sides, who had directed missile planning in OPNAV, maintained that the cognizance dispute "weakened the Navy's position considerably over the years." He recalled (early in 1956) that when he testified before congressional committees, they were "always sitting there laying for me and one question always asked [was] 'Will you please explain to us just what it is that the Bureau of Ordnance does and what it is that the Bureau of Aeronautics does?'" He ran into the same attitude in dealing with OSD, and often heard someone from the Air Force or Army say: "Well, as a matter of fact, there are four Services in the guided missiles field: BuAer, BuOrd, the Army and the Air Force."[61] Assistant Secretary Smith also thought divided responsibility jeopardized the service's missile program, saying it gave "us tremendous difficulty in retaining the Navy in a position to go ahead with missiles at all."[62]

In the summer and fall of 1955, the Navy's inability to speak with one voice about missiles threatened to kill its chance to develop an intermediate range ballistic missile. Deputy Secretary of Defense Reuben Robertson, aware of disagreement within the Navy regarding ballistic missile development, was ready to send a memorandum to the secretary of defense recommending that responsibility for all ballistic missiles be turned over to the Air Force. But in a chance meeting, Under Secretary of the Navy Gates and Assistant Secretary Smith were able to persuade Robertson not to send the memorandum. Gates recalled that "if Mr. Smith and I hadn't happened to be at the right cocktail party we would have been out of business. Frankly, that is how we got back in the business. It was just that much of an accident because Mr. Robertson had made up his mind to assign this business to the Army and the Air Force. . . ."[63]

On 8 November 1955, Secretary of Defense Wilson established two IRBM development programs: a land-based system (later designated Thor) to be managed by the Air Force, and a joint Army-Navy project for another land-based ballistic missile (Jupiter) and a ship-launched adaptation of that system.[64] Given the turmoil in the Navy surrounding the responsibility for missile development, it is hardly surprising that the service's top leadership sought an alternative to the bureaus to direct its portion of the joint Army-Navy project.

Origin and Organization of the Special Projects Office

Within a month of Secretary Wilson's decision for a joint Army-Navy IRBM program, Navy Secretary Thomas established a new organization, the Special Projects Office to manage the Navy's ship-launched adaptation of Jupiter, and Admiral Burke recommended Rear Adm. William F. Raborn, Jr., a naval aviator, to be its director. Set apart organizationally from the bureaus, the office was given wide-ranging powers. Thomas had not assigned the task to either the Bureau of Ordnance or the Bureau of Aeronautics for two reasons. First, he knew that choosing one bureau over the other would antagonize partisans of the one not selected. Second, he doubted that either bureau could run the project effectively. The Bureau of Ordnance possessed much of the required expertise but had been indifferent to ballistic missiles. On the other hand, the Bureau of Aeronautics was enthusiastic about the weapon system but lacked sufficient technical talent and facilities. Establishment of the Special Projects Office, however, did not represent a first step toward reorganizing the bureau system. Most Navy officials viewed it as a temporary rather than a permanent addition to the service's acquisition structure.[65]

Vice Adm. William F. Raborn, Jr.
Courtesy, William F. Raborn Papers, Special Collections Research Center, Syracuse University Library.

Vice Admiral William F. Raborn, Jr. (1905-1990)

The underwater launch of a Polaris missile from the nuclear submarine *George Washington* on 20 July 1960, 4½ years ahead of the Fleet Ballistic Missile System program's original schedule, was a triumph for the Navy and U.S. weapons technology. Many factors accounted for this dramatic achievement, but high among them was the leadership ability of the program director, Rear Admiral Raborn.

Born in Texas and raised in Oklahoma, "Red" Raborn graduated from the Naval Academy in 1928. After tours on board a battleship and a destroyer, he qualified as a naval aviator in 1934. This led to flying assignments off the carrier *Lexington* and the sea-plane equipped cruiser *Portland*.

After World War II broke out, Raborn was posted to the Bureau of Aeronautics where he headed the aerial gunnery section, establishing over 40 gunnery schools. In 1944, he became executive officer (second-in-command) of the *Essex*-class carrier *Hancock*, where, on 7 April 1945, a Japanese "Kamikaze" suicide aircraft struck the ship's flight deck, killing 62 of its crew. Raborn was awarded the Silver Star for his direction of casualty assistance and repair of the carrier's deck in time for returning aircraft to land safely.

Following the war, then-Captain Raborn was assigned to the Bureau of Ordnance, commanded the escort carrier *Bairoko*, attended the Naval War College, and served as deputy to Rear Adm. John H. "Savvy" Sides in the Guided Missiles Division of OPNAV, the staff of the chief of naval operations. In May 1954, he returned to sea as commanding officer of *Bennington*, another *Essex*-class carrier. On 26 May, three weeks after Raborn assumed command, *Bennington*, under way off Rhode Island, was ravaged by explosions and fires below decks involving one of its hydraulic catapults. The disaster claimed the lives of 102 sailors and injured 118, many badly burned. A court of inquiry exonerated Raborn and he received the Bronze Star for heroism. Officers in command when accidents of this kind occur often find their careers at an end. Raborn did not experience this fate. In May 1955, he was assigned to the staff of the commander-in-chief of the U.S. Atlantic Fleet and promoted to rear admiral two months later.

In November 1955, Admiral Burke, the chief of naval operations, personally selected Raborn to head the Special Projects Office, the organization established to develop the Polaris missile system. To some, Raborn may have seemed a curious choice. Although, in previous assignments in Washington, he had been "mixed up in research and development," as he put it, Raborn was a sea-going line officer, not a technician. He lacked advanced education in science or engineering and had never directed a weapons acquisition project. None of that mattered to Arleigh Burke. Years later, Burke told interviewers that the officer he wanted "didn't have to be a technical man. He had to be able to know what technical men were talking about. He had to get a lot of different kinds of people to work [together]." The CNO believed Raborn possessed those qualities.

Admiral Burke chose wisely. Raborn proved to be a charismatic leader, able to convince uniformed military, civil servants, and contractor personnel in laboratories, factories, and shipyards of the importance and urgency of what they were doing and to inspire their complete dedication. His message was simple and powerful: Soviet ICBMs could destroy the nation, but Polaris, which could not be detected, could neutralize the threat. According to Harvey Sapolsky, leading scholar of Polaris development, making the system succeed became a religion and Raborn its chief evangelist.

In 1962, Raborn left the Special Projects Office, returning again to OPNAV as deputy chief of naval operations for development. He retired from the Navy in 1963 and moved swiftly through the revolving door of the military-industrial complex, becoming a vice president of Aerojet General Corporation, contractor for the Polaris missile's propulsion system. In 1965 President Lyndon Johnson, who admired Raborn's administrative skills, named him to head the Central Intelligence Agency. After a difficult 14 months in that job, Raborn resigned, returning to Aerojet General and later starting his own consulting firm.[1]

In little more than a year after its creation, the Special Projects Office's mission changed dramatically. Initially it was responsible only for the ship-launched version of the liquid-fuel Jupiter being developed by the Army. But never enthusiastic about using liquid propellant missiles at sea, the Navy and the Special Projects Office continued to explore the feasibility of a solid propellant missile even while involved with Jupiter. In December 1956, as noted earlier, information regarding anticipated advances in both solid-fuel propellant and warhead technology convinced the secretary of defense to let the Navy leave the joint venture and pursue development of a solid-fuel missile. Early in 1957, the Special Projects Office's new objectives and timetable had been set: launch a missile from a submarine on the surface by 1 January 1963 and from a submerged submarine by 1 January 1965. Following the Sputniks in the fall of 1957, the timetable for submerged launch was advanced to November 1960.[66]

The change in mission brought significantly expanded tasks. Previously charged only with the ship-based aspects of Jupiter, the Special Projects Office now assumed "cradle to the grave" responsibility for a complete system. As sole manager for Polaris, it would develop, test, and produce the missile as well as its launch, fire control, and navigation systems; coordinate the construction of the nuclear-powered submarines and the development of communications systems; train all personnel, including submarine crews; conduct testing; construct and equip production facilities including buildings and tooling; and manage all fiscal and other resource matters for the program.[67]

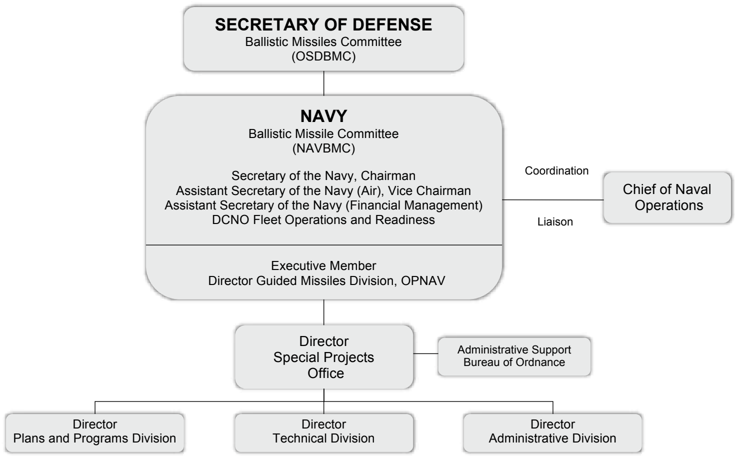
Despite the formidable nature of its tasks, the Special Projects Office possessed substantial advantages. It benefited first from the "highest priority" designation the Eisenhower administration had given both the ICBM and IRBM programs. Rear Admiral Raborn, its director, also enjoyed the complete support of the chief of naval operations. In the memorandum appointing him to head the Special Projects Office, Admiral Burke wrote: "If Admiral Raborn runs into any difficulty with which I can help, I will want to know about it at once along with his recommended course of action for me to take. If more money is needed, we will get it. If he needs more people, these people will be ordered in. If there is anything that slows this project up beyond the capacity of the Navy Department we will immediately take it to the highest level. . . ."[68] Finally, special reporting, planning, and funding provisions made the SPO's work easier by freeing the organization from most administrative and fiscal restraints. These arrangements were comparable to those enjoyed by the Air Force's ICBM program, headed by Brig. Gen. Bernard Schriever. Raborn reported directly to the secretary of the Navy, who chaired the service's Ballistic Missile Committee, which reported in turn to the OSD Ballistic Missiles Committee. The Special Projects Office also wrote its own development plan, prepared and defended its own budget, and exercised full control of funds appropriated for the program.[69]

Headquartered in Washington, D.C., the Special Projects Office grew in size as the ballistic missile program expanded in importance and scope. When first organized in late 1955, it had been authorized a relatively small staff, 45 officers and 45 civilians. A year and a half later, 160 people, including clerical personnel, were assigned to the SPO's headquarters and 134 to field offices.[70] By mid-1961, the organization numbered 200 officers and 667 civilians. Of these, 86 officers and 296 civilians were in Washington, the rest in the field.[71] At that time, more than 11,000 contractors were involved in the program whose annual budget had grown to $2 billion.[72]

The Special Projects Office's internal organization remained fairly constant. Raborn's immediate office included a deputy director, chief scientist, an assistant for shipbuilding (a rear admiral who was at the same time an assistant chief of the Bureau of Ships), an assistant for medical effects, and an assistant for engineering services. Below the director's office were two divisions—Technical, and Plans and Programs. Headed by a technical director, the Technical Division was divided into several branches responsible for Polaris' subsystems. After the shift from Jupiter to Polaris, a missile branch was added to the Technical Division. In addition to the branch chiefs, the technical director was assisted by a chief engineer, technical plans officer, and assistants for weapon systems effectiveness, communications, system development and analysis, material support, and production planning and control. The Plans and Programs Division contained three branches, and its director had one special assistant, for advanced management systems. In 1960, the Special Projects Office added the Administrative Division to provide administrative services and support.[73]

Although organizationally apart from the bureaus, the Special Projects Office was still dependent on them to achieve its objectives. In fact, the Bureau of Ordnance had been designated the "dominant" bureau for the Polaris program.[74] What this meant in practice, however, was that the bureau provided administrative support to the Special Projects Office, particularly assistance in drafting contracts and other legal services. Together with the chief of naval communications, the Bureau of Ships controlled submarine systems, supporting ship designs, and communications systems. Moreover, Rear Admiral Rickover, the bureau's assistant chief for nuclear propulsion, exercised an iron grip over the reactors. Eventually, 15 Navy laboratories participated in the program.[75] Sometimes Raborn found dealing with the large and decentralized Navy acquisition structure frustrating. "My organization being essentially a vertical one," he complained, "finds it difficult to exist in a Navy organized exactly on horizontal lines because we invariably run into a lot of strata of organizations which are not particularly helpful. . . ."[76] For their part, the bureaus feared that Polaris would soak up funds and other resources needed for their own programs. Even so, they saluted smartly and responded well to the requests from the Special Projects Office. Reportedly, successive chiefs of the Bureau of Ships told Raborn: "You may consider BuShips to be your subcontractor."[77]

ORGANIZATION OF FLEET BALLISTIC MISSILE PROGRAM (POLARIS)



Sources: Ltr, Secretary of the Navy to Distribution List, 21 December 1956, Sub: Charter for Navy Ballistic Missiles Committee, folder A20 (Boards, Committees, and Commissions), box 8, Op–00 files, OAB, NHC, and Harvard Business School Weapons Acquisition Project, unpublished draft of "A Case Study of Polaris: Top Priority Long-Range Ballistic Missile Development," n.d. but ca.1959 – 1960, II: fig. 2. Copy provided to author by Frederic M. Scherer.

Although able to draw on the Navy's in-house technical expertise and facilities, Polaris, just as most other major weapon programs of the day, relied heavily on private-sector contractors, either from industry or from universities. The nature of the Special Projects Office's relationship with its contractors had been shaped by the government-contractor links established by the Army for Jupiter. In that program, Chrysler served both as overall weapon system manager and as prime contractor for the liquid-fuel missile. When the Navy withdrew from the Jupiter project, it decided not to enlist a weapon system manager from the private sector, viewing neither Chrysler nor Lockheed (the eventual contractor for the solid-fuel missile) as suitable for this role. The Special Projects Office carried out the weapon system manager function itself. At the same time, the Navy continued the cost-reimbursement contractual arrangements it had already established for missile launching and handling, and missile testing and instrumentation, but engaged new contractors for guidance and propulsion.[78]

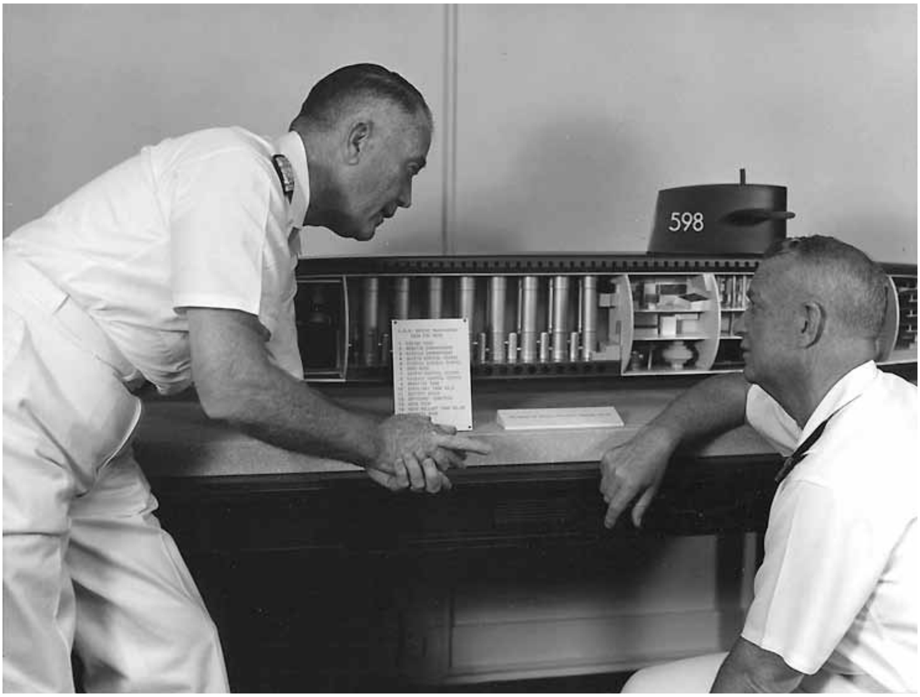
In the Air Force's ballistic missile program, the Ramo-Wooldridge Corporation was in effect the weapon system manager, providing technical direction and systems engineering. The Air Force retained ultimate authority over major program decisions and the program's associate contractors (see chap. 9). The military and civilian personnel assigned to the Special Projects Office were generally more technically qualified than their counterparts in the Air Force's Western Development Division and exercised technical direction. But as Harvey

Sapolsky, author of the classic study of the Fleet Ballistic Missile system, points out, the Special Projects Office's staff "could not have itself managed the Polaris development."[79] In the Navy program, responsibility for technical direction and systems integration was shared among the SPO staff, the subsystem contractors, and two contractors hired specifically to assist in systems integration, the Vitro Corporation and the Applied Physics Laboratory at Johns Hopkins University. No private contractor, however, possessed the same degree of technical authority exercised by the Ramo-Wooldridge Corporation in the Air Force program.[80]

The SPO's Steering Task Group, organized shortly after worked stopped on Jupiter, oversaw the Polaris system's technical development. Chaired by the SPO's technical director, Capt. (later Rear Adm.) Levering Smith, from 1955 to 1962, the Steering Task Group was an important forum for establishing performance goals, identifying and selecting system tradeoffs and design alternatives, and monitoring program progress. Its members included representatives from major contractors and from Navy and other government agencies who were organized into subcommittees for the system's major functional areas (e.g., missile, submarine design, communications). The subcommittees, normally chaired by the SPO's Technical Division branch heads, met monthly to review technical issues and progress in their respective areas and forwarded reports to the Steering Task Group.[81]

Rear Admiral Raborn kept track of the program in two principal ways. He received reports from the Progress Analysis Branch (operating covertly) of the SPO's Plans and Programs Division. He also met weekly, initially on Saturday mornings but later on Mondays, with key staff members in a secure conference room known as the "Management Center."[82]

The Special Projects Office, as weapon system manager for a time-urgent and complex program whose different elements were, like the Air Force's Atlas, "moving ahead with everything and everybody, altogether and at once," also implemented evaluation and management tools to measure progress and tie all parts of the program together into a coordinated whole. Initially, the SPO employed simple milestone reporting to provide information on actual versus scheduled progress. In 1958, assisted by the management consulting firm of Booz, Allen & Hamilton and by Lockheed, prime contractor for the missile, the SPO designed, developed, and implemented a much more sophisticated tracking method—PERT, Program Evaluation Review Technique.[83] PERT illustrated the relationship between the events involved in completing a particular task and different time estimates (most optimistic, most likely, most pessimistic) for completing each. It also identified "the critical path"—the longest expected time sequence for a series of events determined by a mathematical formula—that had to be followed to realize task completion. PERT, however, was conceptually flawed and had little, if anything, to do with the Polaris program's success. Its primary value was as a public relations device conveying the impression to outsiders that the SPO had devised "an integrated management system that could cope with the complexities of technological development."[84]



Rear Admiral Raborn (left) and Admiral Burke examine a model of the ballistic missile submarine USS *George Washington* (SSBN–598), July 1959.
Courtesy, Naval History and Heritage Command.

When *George Washington* fired the first Polaris missile in July 1960, the Special Projects Office, under Raborn's leadership, had beaten by several months the accelerated schedule established after the Sputniks and the original timetable of 1 January 1965 by 4½ years. Many attributed this success to the SPO's vertical, project-type organization that contrasted sharply with the bureaus' functionally organized weapon system development programs. But most Navy leaders believed that the top priority and organizational structure that characterized the Polaris system could not be applied across-the-board to the service's other weapon system programs.[85] Multiple projects could not all be assigned the top priority; financial and personnel resources were finite. Rear Adm. Rawson Bennett II, the chief of naval research, noted the drain on talented people caused by a special project office:

> [Someone] estimated that five percent of the people in the world run everything. . . . Every time you man a special project you chew up an ungodly percentage of that five percent. Therefore the rest of your organization is bound to be run much worse. We cannot . . . afford very many projects or we will have no good people to run the rest of the Navy's business.[86]

Moreover, numerous centrally directed project offices would be incompatible with the Navy's horizontal and functional organizational pattern. Indeed, in 1958, Rear Adm. John Hayward, the assistant chief of naval operations for research and development, told the Defense Science Board that the Navy could afford no more than four SPO-type organizations without disrupting the service's organizational structure.[87]

The Libby Board and the Lead Bureau Concept

Early in January 1956, soon after the establishment of the Special Projects Office, Admiral Burke appointed a board headed by Vice Adm. Ruthven E. Libby, deputy chief of naval operations for plans and policy, to "Study and Report upon the Adequacy of the Bureau System of Organization." The focus of the investigation was to be whether the Bureau of Ships, the Bureau of Ordnance, and the Bureau of Aeronautics were up to the task of developing and delivering the advanced weapon systems required by the Navy. And, if not, could they be made more responsive by making adjustments to the existing structure or would a different type of organization be required.[88] In March, the Libby Board reported that it had found deficiencies in the bureau system—and elsewhere in the Navy—with respect to weapons acquisition, but concluded that administrative and procedural changes would be able to correct these problems and that major reorganization was not necessary. The board's principal recommendation—institution of a "lead bureau" for development of systems that cut across bureau lines—became Navy policy for the remainder of the decade and into the next.

The Libby Board's examination of the bureaus' performance seemed necessary for several reasons. Creation of the Special Projects Office clearly demonstrated that the Navy's top officials lacked confidence in the ability of the bureaus to produce weapons of the future fast enough.[89] Furthermore, still on the table was Admiral Burke's early September 1955 proposal to make the Bureau of Ordnance the "dominant" bureau for ship-launched missiles and the Bureau of Aeronautics dominant for air-launched systems. Assistant Secretary Smith had challenged this solution to the dispute over missile cognizance, suggesting instead that reorganization might be needed. Navy Secretary Thomas had yet to decide the issue. Finally, the Robertson committee, organized by OSD in September 1955 to find ways to shorten the acquisition cycle for manned aircraft weapon systems (see chap. 8), had, according to Under Secretary Gates, "got us thinking about the responsiveness of the bureau system to weapons development."[90]

With the exception of the chief of naval operations and the secretary of the Navy, virtually every top-ranking uniformed and civilian Navy official connected with acquisition as well as witnesses from OSD, industry (all but one retired flag officers), and the scientific community testified before the Libby Board in early 1956.[91] Many of those appearing described coordination problems with systems that depended for subsystems on more than one bureau. Missiles were most often cited. For example, Rear Admiral Sides, the former chief of guided missile planning in OPNAV, recalled the lack of communication between the Bureau of Aeronautics and the Bureau of Ships regarding test equipment for the surface-to-surface Regulus:

> BuAer had changed the airborne electronics to an extent it was no longer compatible with the checkout van which BuShips was procuring and BuShips was well into procurement and [the] delivery date was about one month off when we discovered this. It meant we would have had no capability in cruisers or carriers for another six months or so, . . . If there had been a dominant bureau who was on top of everything, this could not have happened. You could not have changed the electronics to where they were no longer compatible with the shipboard checkout van without the shipboard people finding out about it.[92]

Rear Admiral Bennett, the chief of naval research, reported that in the case of the surface-to-air Talos, "there was not the proper interchange of information to properly design the long-range radar. In fact it took from February 1954 until fairly recently [1956]. . . for the Bureau of Ships to finally get from BuOrd the full technical details of what BuOrd required from the long-range search and acquisition radar."[93] Some officers noted the Bureau of Ordnance's failure, even after the required technology had become available, to develop a proximity fuze that would enable BuAer's Sparrow I air-to-air missile to be effective at a range of less than 1,000 feet even though the Bureau of Ordnance knew that the Bureau of Aeronautics desired such a capability.[94] But missiles were not the only systems reflecting inadequate coordination among the bureaus. Vice Adm. M. E. Curts, the deputy commander-in-chief of the Pacific Fleet, told the board that the Navy had for years been developing aircraft that could not operate from existing carriers. As a result, "we have got a bad two or three years in the Pacific right now operating our carriers with the aircraft that are on them and it is a very bad situation. A dangerous one and a bad one."[95]

Despite the numerous examples of inadequate bureau interface, none of the witnesses thought the bureau system should be abolished. Some, primarily from the naval aviation community, recommended that the Bureau of Ordnance and the Bureau of Aeronautics be merged.[96] Most, however, believed that the existing bureau structure could develop the advanced weapon systems needed by the fleet. Any shortcomings, they suggested, could be addressed through administrative and procedural adjustments.[97] The Libby Board's report would echo this majority view.[98]

After hearing witnesses, and in accord with its charge, the board considered several alternative forms of organization. It concluded that none was preferable to the organizational status quo. Although effective, the SPO approach should be employed "only in exceptional circumstances" due to its "inherently disruptive effect" on the Navy's regular organization.[99] The board completely rejected other organizational patterns. These included an umbrella logistics command under the chief of naval operations; a single technical bureau to replace the Bureau of Ships, the Bureau of Ordnance, and the Bureau of Aeronautics; the merger of BuOrd and BuAer; and a reorganization of the three material bureaus around individual weapon systems, complexes of weapon systems, or type warfare lines.[100]

In lieu of reorganization, the board recommended implementation of a method that involved designating one bureau, the "lead bureau," to direct a weapon system program and to be responsible for coordinating the activities of other participating bureaus. Cognizance over new weapon systems involving more than one bureau should be decided case-by-case, and this determination should be based on the availability within the bureau of the skills and specialties needed to develop the system.[101]

Among other recommendations bearing on bureau coordination, the board also proposed to modify and revitalize the inter-bureau technical committees (see chap. 7) by establishing an Inter-Bureau Technical Group to advise the bureau chiefs. Additionally, a newly formed Executive Council, composed of the under secretary of the Navy and two of the assistant secretaries (air and material), the chief of naval research, the chief of naval material, and the chiefs of the Bureaus of Ships, Ordnance, and Aeronautics, would consider matters referred by the Inter-Bureau Technical Group and act as a senior council on development and production matters.[102]

The Libby Board recognized that the bureaus were not solely responsible for deficiencies in weapons acquisition. If the bureaus too often viewed weapons from a subsystem rather than a systems perspective, some of the fault belonged to OPNAV where operational requirements originated in the Office of the Deputy Chief of Naval Operations for Fleet Operations and Readiness (Op–03), and in the Office of the Deputy Chief of Naval Operations for Air (Op–05). The surface, undersea, and nuclear desks in Op–03 and the guided missile and air desks in Op–05 tended to approach weapons and requirements from the relatively narrow perspective of their own warfare specialties.

In late 1950, the New Developments and Operational Division had been set up in OPNAV to review, coordinate, and issue all requirements to the bureaus on behalf of the chief of naval operations (see chap. 8). The Libby Board, however, concluded that the New Developments and Operational Division was not adequately staffed to assess operational requirements by systems Navy-wide. To perform this function and to coordinate the Navy's research and development program, the board recommended that a new assistant chief of naval operations position be added to OPNAV. Subsequently, in mid-1956, the chief of naval operations established the post of assistant chief of naval operations for research and development under the deputy chief of naval operations for fleet operations and readiness (Op–03). Early in 1958, the then-assistant chief of naval operations for research and development began to report directly to the vice chief. Assigning responsibility for coordinating research and development activities in OPNAV to an assistant chief of naval operations and separating the position from the deputy chiefs of naval operations reflected not only the increasing importance of research and development but also the CNO's direct involvement in it.[103]

The Reorganization of 1959

The changes initiated by the Libby Board in early 1956 did not result in effective coordination of Navy weapon systems development. Implementation of the lead bureau concept got off to a very slow start and, after finally becoming official policy in 1957, fell short of expectations.

In contrast to the relatively short two-month period it had taken for the Libby Board to conduct hearings and issue a report, implementation of the board's recommendations, in terms of ship speed, moved at no better than the slow "ahead one-third" (about 5 knots). In line with normal bureaucratic protocol, the chief of naval operations asked those most affected—the bureaus and Office of Naval Research—to comment on the board's findings. None objected to the lead bureau proposal.[104] But drafting and coordinating the instruction to be signed by the secretary of the Navy that would make the lead bureau official policy awaited establishment of the position of assistant chief of naval operations for research and development in July 1956.[105] Not until August 1957, close to a year and a half after the Libby Board submitted its report, was the instruction published.[106]

Even after its institutionalization, the lead bureau method of coordination proved to be inadequate for two principal reasons. First, the lead bureau lacked complete control over an acquisition program's funding; it managed appropriations for research, development, test, and evaluation (RDT&E), but not funds for production. Second, although charged with technical direction of a program, the lead bureau could not exercise executive authority over participating bureaus.[107]

During the nearly year and a half that it took to approve the lead bureau concept, the conflict between the Bureau of Ordnance and the Bureau of Aeronautics over guided missiles reignited. Ironically, OPNAV initiated the confrontation. At a meeting attended by the chiefs of BuOrd and BuAer at the end of January 1957, Rear Adm. J. E. Clark, head of the Guided Missiles Division in OPNAV and a naval aviator, suggested that the Triton surface-to-surface missile program, then being run by the Bureau of Ordnance, should be turned over to the Bureau of Aeronautics.[108] This made partial sense in that the long-range Triton, like BuAer's Regulus I and Regulus II, was an air-breathing cruise missile. But only some sense. That the Bureau of Aeronautics had any responsibility for surface-to-surface missiles at all had seemed odd to many observers for years.

BuOrd's chief, Rear Adm. F. S. Withington, for some reason deciding that a full-scale bombardment against a deeply entrenched position, however futile the probable outcome, was the best defense against possible loss of the Triton program, proposed to Rear Admiral Russell, his counterpart in BuAer, that together they suggest to Admiral Burke that the Bureau of Ordnance assume cognizance over all Navy guided missiles. "[D]ivided responsibility," he wrote

Russell, "is rapidly becoming impossible to justify." If the Bureau of Aeronautics could not go along, said Withington, then Russell should agree to a division by launching platform—the previously rejected solution that would have assigned surface and subsurface-fired missiles to the Bureau of Ordnance and air-launched missiles to the Bureau of Aeronautics.[109] Russell, not surprisingly, dismissed both propositions, saying that he stood by his earlier recommendation that the two bureaus be merged. Should that not take place, then the chief of naval operations should determine responsibility according to bureau competence and experience. In a remark that must have been particularly galling to Withington, whose bureau had been relegated to providing administrative support to the Special Projects Office, Russell said that transferring Triton to the Bureau of Aeronautics would "free the Bureau of Ordnance to devote its undivided attention to the surface-to-surface weapon of transcending importance, the ballistic guided missile."[110]

Following Russell's refusal, Withington presented his case to the chief of naval operations. "Since World War II," he wrote Admiral Burke, "both Bureaus have suffered immeasurably in competition with the other two services for available funds, at all reviewing levels in the Department of Defense, with the Bureau of the Budget and on Capitol Hill because of the patched-up, glued-together, ill-prepared and ill-presented guided missile program of the Navy." To correct this image and to ensure that naval weapon systems were properly integrated, Withington recommended establishment of a "Bureau of Weapons" that would use the existing structure of the Bureau of Ordnance as the basis for the new organization. All Bureau of Aeronautics–directed guided missile programs along with their supporting resources would be transferred to the Bureau of Weapons. The Bureau of Aeronautics would retain responsibility for the development and procurement of piloted aircraft and act as lead bureau for airborne weapon systems with the weapons themselves coming from the new bureau in response to requirements set by the Bureau of Aeronautics. Withington told Burke that he knew the reorganization would "generate hardship" and "perhaps anger and ill-will in some quarters." Nevertheless, he believed that "only through such drastic action can our all-important guided missile program be brought back to respectability in the eyes of our own secretaries and those of many other persons outside the Navy who can make or break us."[111]

Admiral Burke did not act on Withington's recommendations, but he began to change his mind with respect to bureau reorganization, an action that he had considered too disruptive in late 1955. In a note to Admiral H. D. Felt, the vice chief of naval operations, Burke conceded that the basic idea [Bureau of Weapons] was "logical." But, since human emotions were involved, it "wouldn't work without the wholehearted support of all interested parties." The CNO thought it better to work along with the present setup while marshaling the support that would ultimately make a new organization more effective.[112]

The bureau restructuring issue lay dormant for nearly a year and a half until enactment of the Department of Defense Reorganization Act of 1958 prompted the Navy to reexamine its own organization. On 13 August 1958, a week after the president had signed the legislation, Rear Adm. K. M. McManes, the deputy chief of naval operations for administration, reported to the chief of naval operations that coordinating the acquisition of new weapons suffered from divided responsibilities among the bureaus, shortcomings in the lead bureau concept, and competition among the bureaus for funds and for the services of the aircraft and electronics industries.[113] Two weeks later, now Secretary of the Navy Gates appointed a committee to study the department's organization. Chaired by Under Secretary William B. Franke, it was to consider changes that might be necessary as a result of the reorganization act and advances in weapons technology.[114] The Franke Committee reported at the end of January 1959. Its three most important recommendations were to merge the Bureau of Ordnance and the Bureau of Aeronautics into a Bureau of Naval Weapons, to establish the position of assistant secretary of the Navy for research and development, and to create a comparable position in OPNAV, the deputy chief of naval operations for development.

Formally established on 1 September 1959, the Bureau of Naval Weapons (BuWeps) was operational by December. The merger of the Bureau of Ordnance and the Bureau of Aeronautics made the new bureau the largest organization in the Navy Department, with nearly 4,500 personnel at its headquarters in Washington, D.C., and over 200,000 in the field. Its annual budget accounted for 40 percent of the Navy's total annual appropriation and 70 percent of the service's RDT&E funds.[115] The Franke Committee maintained that consolidation was necessary because "changes in technology and weapons characteristics, particularly in the field of missiles, have tended to merge the areas of development" that the two bureaus had been carrying out separately. Such an organizational structure, with its divided responsibilities, posed problems of cognizance, coordination, and funding that worked against the need to develop complete weapon systems.[116] Among the advantages of the merger, according to the committee, would be an end to many split-cognizance disputes, simplification of the funding of major weapon systems, and more timely development of subsystems. It also believed that the consolidation would dispense with the need for SPO-type organizations.[117] The committee explained that the Bureau of Ships had not been folded into the new bureau because its functions "could reasonably be set apart" from those performed by the other two bureaus."[118]

The creation of the two new R&D posts at Navy headquarters—the assistant secretary of the Navy for research and development, formally established in February 1959 (and supplanting the position of assistant secretary of the Navy for air), and the deputy chief of naval operations for development, set up in April—was the result of two factors. The first was the perception that the increase in OSD's authority over research and development stemming from the Department of Defense Reorganization Act of 1958 mandated a comparable elevation of the organizational importance of that function in the Navy. The second was a continuation of the gradual trend, under way since the end of World War II, to centralize more power over acquisition in the Navy secretariat and in OPNAV at the expense of the bureaus. Garrison Norton, the new assistant secretary of the Navy for research and development (and Smith's successor as assistant secretary of the Navy for air), would have management responsibility for the service's RDT&E appropriation, the only service secretary to have such authority. Previously control of the appropriation had been fragmented among the secretariat, OPNAV, and the bureaus. Centralizing it in the new assistant secretary position would enable that official to better manage the Navy's research and development program generally, but also, in theory, be more effective in dealing with the Office of the Director of Defense Research and Engineering that had been set up in OSD by the reorganization legislation.[119]

The position of deputy chief of naval operations for development supplanted the post of assistant chief of naval operations for research and development. Its occupant, Rear Admiral John Hayward, moved up to the new position which, unlike his previous office, was provided with a substantial staff. Hayward's principal responsibility was to coordinate and integrate the Navy's research and development program. According to the Franke Committee, all R&D functions carried out elsewhere in OPNAV were to be consolidated under the deputy chief of naval operations for development. Consequently, the Guided Missiles Division was transferred from the deputy chief of naval operations for air (Op–05), as were development activities being administered by the Office of Naval Research. The consolidation, however, was not complete, as some RDT&E responsibilities remained with the deputy chief of naval operations for air and the deputy chief of naval operations for fleet operations and readiness (Op–03).[120] Acting on another Franke Committee recommendation, the deputy chief of naval operations for development organized the new office by weapon system.[121]

The Franke Committee's recommendations substantially increased central direction of acquisition management in the Navy. However, they did not go far enough, particularly with respect to the bureau system, to further significantly one of the committee's most important objectives: ensuring that the weapons development process was sufficiently coordinated among the material bureaus so that new systems would reach the fleet as rapidly as possible and operate effectively when they did. The committee knew that the lead bureau method of system integration had not been working.[122] But since the Bureau of Ordnance and the Bureau of Aeronautics together received two-thirds of the Navy's RDT&E appropriation, it thought that "with the consolidation, the need for the lead-bureau system for weapons systems development would almost disappear since the new bureau would in most cases have development responsibility for entire weapons systems."[123] In reaching this judgment, however, the Franke Committee had badly and incomprehensibly undervalued the Bureau of Ships' role in weapon system integration.

Almost all naval weapons were associated with a ship in one way or another. Their size, weight, and other characteristics profoundly affected ship design and performance.[124] The reverse was also true, as evidenced by the restrictions imposed on aircraft development by the limitations of their carrier launching platforms. Thus, consolidating the development of missiles and other systems in the Bureau of Naval Weapons only solved part of the integration equation.

By the end of the 1950s, electronics was central to the operation of virtually every naval weapon system. And most of these either interacted with or were installed on ships. But development of electronic equipment approached the chaotic. In September 1959, a paper prepared by the Ship Characteristics Division in OPNAV noted that electronic equipment accounted for nearly 40 percent of the cost of a combatant ship. The estimated price tag for a new guided missile destroyer equipped with the Naval Tactical Data System, for example, was $36 million. Approximately $14.5 million of that total cost would be for electronic equipment that was produced by 44 different manufacturers, had been developed and procured by two or more material bureaus, entailed approximately 43 antennae in optimum positions above the deck for maximum performance, and required 16 different kinds of electric power. The paper urged that individual bureaus and sections within bureaus "cease developing electronic equipment for a specific function and with inadequate attention to the ultimate electronic environment in which the equipment would operate." The practice, it pointed out, directly affected fleet readiness. For example, *Galveston*, a light cruiser recently converted to a guided missile escort, had been significantly delayed from joining the fleet because of the need to achieve compatibility in electronic equipment developed separately by the Bureau of Ships and the Bureau of Ordnance.[125]

The exclusion of the Bureau of Ships prevented the merger of the Bureau of Ordnance and the Bureau of Aeronautics into the Bureau of Naval Weapons from achieving the results intended by the Franke Committee. Three years after the change went into effect, the Dillon Board (after its chairman, John Dillon, administrative assistant to the secretary of the Navy) conducted yet another comprehensive review, this time of the department's management. The board's study group examining the management of research and development pointed out the practical impact of the merger: "Under the present BuWeps-BuShips split, the Chief of BuShips is responsible for ship design and for some component design. The Chief of BuWeps is responsible for the weapon, and weapon-related equipment design. No one is really responsible for the composite design—the ship with all its equipment."[126] Cognizance disputes between the two, concluded the study group, had reached "unworkable proportions."[127]

NAVAL AVIATION: TOWARD THE WEAPON SYSTEM APPROACH

Naval aviation, at its post–World War II nadir in 1953, underwent a significant transformation in the rest of the decade. Beginning with *Forrestal* in 1956, the first aircraft carriers designed to accommodate high-performance jet aircraft entered fleet service. To fly from the decks of those ships, the Navy developed jets that proved to be among the most successful in the U.S. aircraft inventory. In response to the weaknesses revealed during the Korean War, the Bureau of Aeronautics revised its aircraft acquisition process. It also sought ways to adapt aspects of the weapon system approach to its established organizational structure and traditional methods of acquiring new aircraft.

The Condition of Naval Aviation at the End of the Korean War

When the Korean War ended, naval aviation was in a dismal state. The straight-wing Grumman F9F Panther and McDonnell F2H Banshee, the Navy's principal air superiority jet fighters when the conflict broke out, quickly showed themselves to be inferior to the swept-wing Soviet MiG–15. As a result, they performed largely in a ground-attack role, depending on the Air Force's swept-wing North American F-86 Sabre to keep the skies free of MiGs and off their tails.[128] To have an opportunity to fight MiGs while flying in Korea, Maj. John H. Glenn, a Marine Corps F9F pilot (and future astronaut, United States senator, and presidential candidate), applied for an exchange tour with an Air Force F–86 squadron during which he downed three MiG–15s.[129] Similarly, Maj. John F. Bolt, the only Marine Corps Korean War ace, downed all six of his MiGs while on exchange duty with the Air Force.[130] Following the war, Bolt spent 32 months in BuAer's fighter design branch. In that assignment, he was project officer for the troubled F3H program. On his departure he sent a memorandum to the BuAer chief that was highly critical of Navy fighter-aircraft acquisition: "For twelve years the fighter planes that have gone to the fleet have been dogs . . . and the fleet and the fleet Marine force [have] become the biggest kennel club on record. . . ."[131] Post–World War II Navy jet-aircraft development had lagged behind the state of the art, in part because the existing *Midway* and *Essex* carrier classes had not been designed to operate jets. Consequently, the Bureau of Aeronautics was forced to sacrifice aircraft performance to carrier limitations.[132]

USAF F–86 Sabre flown by Maj. John Glenn, the "MiG Mad Marine," during the Korean War. Courtesy, National Museum of the U.S. Air Force.

As soon as the Korean War started, the Navy substantially increased orders for existing aircraft and hurried into production planes still under development that had been designed with advanced engines and other subsystems that were as yet unproven or even available. Several of the accelerated fighter and attack aircraft programs encountered significant delays, cost growth, and ultimately cancellation. The Navy estimated that the cost of work and materials for these terminated programs would total approximately $227 million. Additionally, aircraft that entered fleet service from some telescoped programs did not perform up to expectations and required time-consuming and expensive modifications.[133]

In attempting to speed up acquisition by overlapping development and production, the Navy had not operated differently from the other services and, like them, often experienced poor results. In 1957, Admiral Arthur Radford, chairman of the Joint Chiefs of Staff, recalled that when the Korean War began "we went through a rapid and terrifically wasteful build-up. . . . From the most limited resources, the Services were given blank checks. We tried to make up for a lot of lost time in the research and development field. We did make up some time, but at a terrific cost and with a very bad aftermath."[134] In making this assessment Radford, a naval aviator, likely had several of his own service's aircraft programs in mind. After the war, revelations about one of these, the acquisition of the F3H–1 Demon, a swept-wing, all-weather fighter proved especially embarrassing to the Navy.

F3H Demons in formation, December 1958.
Courtesy, Naval History and Heritage Command.

In January 1951, six months after the outbreak of the Korean War, the Navy decided to change the role of the F3H–1, then being developed by McDonnell Aircraft, from short-range fighter interceptor to medium-range general purpose fighter.[135] The shift required some redesign and more than a 30 percent increase in the aircraft's weight. Although the F3H–1 prototype would not make its first flight until August, the Navy contracted with McDonnell for quantity production in March. The F3H–1's power plant was to be the high-thrust version of Westinghouse's J40 engine, then also under development and ordered into mass production at the same time by a contract with Ford Motor Company under license from Westinghouse. The Navy and Westinghouse believed the J40's performance would be more than sufficient for the heavier F3H–1.[136]

The high-thrust J40, however, ran into severe development problems. While Westinghouse continued to work on the engine, the Navy accepted an already-developed lower-thrust version for installation in the first 150 production F3H–1s. These would be retrofitted with the advanced engine when it became available. At the time, McDonnell pointed out that F3H–1s with the less-capable J40 would be underpowered. By the end of 1952, Westinghouse conceded that it had been too optimistic and would not be able to meet the program's goals for a high-thrust engine. In the meantime, the Navy had been evaluating Pratt and Whitney's J57 engine and Allison's J71 engine as alternatives to the J40. In the summer of 1953, deciding that the Allison engine would best meet its needs, the Navy directed McDonnell to substitute it for the Westinghouse J40 engine in the F3H–1, beginning with the 61st production aircraft, and to designate subsequent units the F3H–2.[137] When production ended in 1959, McDonnell had built 459 F3H–2s.[138]

None of the F3H–1 aircraft with the lower-thrust J40 engine saw fleet service. Eight were involved in accidents, with five of those destroyed and three pilots killed. The Navy believed that the Westinghouse engine was directly responsible for three of the accidents and a factor in one other. Of the remaining aircraft, four were engaged in flight testing, thirty retrofitted with the Allison J71 engine, and twenty-one assigned as ground trainers for mechanics or for other non-flying uses.[139] McDonnell, the builder, and the Navy suffered the ignominy of newspaper photographs showing F3H–1 airframes being towed through the streets of St. Louis (the company's plant was located at Lambert Field, on the city's western outskirts) to be loaded on barges on the Mississippi River for transportation to various training facilities.[140] When the F3H–1 program ended, more than $238 million had been spent on the airframe and the J40 engine.[141]

Problems with the F3H–1 came to light in the latter half of 1955, prompting congressional investigations that generated considerable publicity.[142] After holding hearings in late October, the Military Operations Subcommittee of the House Committee on Government Operations issued a report in March 1956. It found "no indications of dishonesty or improper influence" with respect to the F3H–1 contracts, but said that Westinghouse, McDonnell, and the Navy (but principally the latter as the government's procuring agency) shared responsibility "for errors of judgment and waste of public funds."[143] Among its several recommendations, the subcommittee suggested that the Navy should consider placing primary responsibility on the aircraft manufacturer for subsystem coordination, including engine procurement, and for "package delivery of flight-tested aircraft"—in short, adopt weapon system contracting.[144]

For its part, the Navy—at least Rear Admiral Russell, BuAer's chief—had no apologies for taking calculated risks in developing advanced weapon systems, such as the F3H–1, that it believed would enable the United States to maintain technological superiority over potential enemies. At a BuAer division directors' conference in early October 1955, Russell said that the Navy had "nothing to hide. The J40 represented a little daring in engineering." He thought it might have been better handled from a public relations perspective, but we should "make clear that if we took a considered chance and it turns sour, that's that."[145] On the other hand, Secretary of the Navy Thomas conceded that initiating quantity production of the F3H–1 before determining that the J40 could produce the required thrust might be open to criticism. But the Navy, he told Senator Lyndon Johnson, chairman of the Senate Preparedness Investigating Subcommittee, had already revised its procurement process to "prevent the recurrence of a similar situation."[146] The new procedures were known as FIRM, or Fleet Introduction of Replacement Models.

FIRM, the F8U–1 Crusader, and Concurrency

The notoriety of program failures such as the F3H–1 was bad enough. But BuAer's practice of releasing aircraft for quantity production before development, including test and evaluation, had been completed could mean adverse consequences for the fleet. When development and production overlapped, time-consuming and expensive modifications usually had to be made to aircraft that had already been manufactured. If the changes were made before delivery, then the fleet was deprived of timely receipt of the most advanced systems, defeating concurrency's supposed purpose. If the modifications took place after delivery, then until they were made, operational units had to contend with underperforming, unreliable, or unsafe systems and aircraft out of service for extended periods. The Fleet Introduction of Replacement Models (FIRM) plan, BuAer's solution to this dilemma, was first proposed at the end of 1953. Its application in the acquisition of the F8U–1 Crusader, a supersonic air-superiority fighter, set the standard for subsequent Navy aircraft programs.

At its core, FIRM involved the manufacture and testing of a limited number of units of a new aircraft model before quantity production began. This method of production control sought, on the one hand, to avoid the consequences of the rapid buildup of unproven systems experienced during the Korean War, and, on the other, to ensure that the fleet received advanced, combat-ready systems as rapidly as possible. The concept was first presented to the Navy's Air Board by Capt. J. N. Murphy of the Bureau of Aeronautics in December 1953, and then issued as service-wide policy by OPNAV in October 1954. At this point, the procedures had not yet acquired the formal name (and acronym) they would later assume.[147]

In January 1955, the Department of Defense announced the Navy's revised aircraft acquisition policy. The new procedures focused on production control and testing, but also included other elements. According to the FIRM plan, a low rate of production would be followed during the first three years with all of the planes manufactured during that period (25 to 30) going directly into the test program. Fleet delivery and release for quantity production would be withheld until virtually all testing (contractor, BuAer, service) had been completed and necessary modifications made on the production line. In addition to this production scheduling and testing protocol, the new policy called for designing the first experimental prototype for quantity production and for manufacturing it with production tooling. The plan also provided for pilot-line production of complex subsystems before their installation in a particular aircraft and for developing alternate or "back up" subsystems that might be substituted for the planned subsystem should that be necessary. Finally, FIRM assigned private industry—the aircraft manufacturer—a greater role in managing system development: "The airframe manufacturer is being given increased responsibility for system coordination. It will be his responsibility to integrate and correlate various related components, furnished either by the Government or the contractor, into a completely coordinated system."[148]

With respect to the low initial production rate, FIRM mirrored the "Cook-Craigie" concept that became Air Force policy in January 1953. It also conformed to OSD's insistence that production be considered during design, and that quantity manufacture not take place before systems were proven through testing. According to Rear Adm. Robert E. Dixon, deputy and assistant chief of the Bureau of Aeronautics, the new policy reflected the "more conservative attitude" toward aircraft development that resulted from "some of our sad experiences from the Korean era."[149] But FIRM was no return to the sequential acquisition strategy of initiating quantity production only after one or two prototypes were thoroughly tested that had been in effect in the Navy prior to and through part of World War II. The last Navy fighter to reach the fleet using the competitive prototype, sequential acquisition strategy was the Vought F4U Corsair, a program that had been initiated in 1938 with deliveries beginning to operational units in October 1942.[150] The FIRM plan preserved the strategy of concurrent development and production that the Bureau of Aeronautics believed essential for supplying cutting-edge systems to the fleet before they became obsolete. In fact, since production activities began before the prototype aircraft made its first flight, concurrency was inherent in FIRM.

F8U Crusader catapult launch from the carrier USS *Hancock* (CVA–19), November 1957. Courtesy, Naval History and Heritage Command.

The progress and outcome of the F8U Crusader program was what the Navy had in mind when it instituted the FIRM plan. Built by Chance Vought Aircraft, the F8U was a supersonic, variable incidence and swept-wing, single-seat jet designed to maintain air superiority in daylight and fair weather. Powered by the advanced Pratt and Whitney J57 engine, the Crusader was "a significant, although not radical, advance in the state of the art."[151] It was the Navy's first supersonic fighter and the world's first production aircraft to exceed 1,000 mph (almost 870 knots) in level flight.[152]

The chief of naval operations had issued a requirement for a supersonic day fighter in early July 1952. In mid-September, the Bureau of Aeronautics opted for a design competition to fulfill the requirement.[153] In the 1950s, the Navy's approach to source selection for new aircraft differed in one important respect from that followed by the Air Force. Both services had abandoned the earlier practice of open bidding. Instead, only those manufacturers thought capable of developing and producing the system were asked to submit a proposal. Both services also held "paper" competitions. The key difference was that the Navy required competitors to submit a detailed design. In contrast, by the mid-1950s, the Air Force requested its prospective competitors to address their qualifications as contractors and to describe the approach they intended to follow in developing the system. Thus, the Navy conducted a technical analysis, while the Air Force ran (initially) a management analysis. From the contractor submissions it received, the Air Force then selected two or three to engage in a design competition.[154]

Edward H. Heinemann, aircraft designer and chief engineer, Douglas Aircraft Company, 1931–1960.

Edward H. Heinemann (1908-1991)

For a time during the 1960s, more than half of the Navy's carrier-based fighter and attack aircraft reflected the design genius of Edward Heinemann, chief engineer for the Douglas Aircraft Company from 1936 to 1960. His name is synonymous with simple, functionally designed, rugged, and long-lived aircraft such as the Army Air Forces A–26 (later B–26) Invader ground attack bomber, which flew combat missions in World War II, the Korean War, and the Vietnam War.

Born in Saginaw, Michigan, in 1908, Heinemann, whose father was in the furniture business, moved with his family a few years later to California. The epitome of the self-taught man, Heinemann attended but did not graduate from Manual Arts High School in Los Angeles, wanting instead to apply what he had learned of the mechanical arts as soon as possible. In 1926, after a year with the Yankee Motor Body Company of Los Angeles drawing plans for ice wagons, fire engines, school buses, and truck bodies, he was hired as a draftsman by J. H. "Dutch" Kindelberger, then Douglas Aircraft's chief engineer (and later president of North American Aviation). In about a year, the company's failure to win some expected contracts forced Heinemann's layoff, along with half of Douglas' engineering force of 30. In 1931, after brief periods of employment with other aviation companies including Jack Northrop's firm, he was rehired by Douglas. In the interim, he had learned to fly in a Curtiss Jenny, making three exhibition parachute jumps to help pay for the lessons.

At Douglas, Heinemann rose quickly, becoming the chief engineer at the company's El Segundo Division in 1936, and vice president for engineering in 1958. In his nearly quarter-century as head of engineering, he designed more than 20 fighter, bomber, and rocket-powered research aircraft, primarily for the Navy. Distinguished Heinemann-designed aircraft during World War II included Army Air Forces ground-attack bombers, the previously mentioned A–26 Invader and A–20 Havoc, and the Navy's SBD Dauntless dive bomber, which played a crucial role at the battles of Coral Sea and Midway in 1942. Among Heinemann's postwar "winners" (as he called them), designed for the Navy, were the AD Skyraider ground attack bomber that was developed just before the end of World War II and saw combat in Korea and Vietnam; the F3D Skynight and F4D Skyray jet interceptors; the A3D Skywarrior heavy attack jet bomber; and a ground attack jet bomber, the A4D Skyhawk, also known as "Heinemann's Hot Rod," whose relative light weight (under 16,000 lbs. combat weight) countered the trend for U.S. jet interceptors and fighter-bombers to become heavier and more complex.

In 1960, Heinemann left Douglas Aircraft, taking a senior position at Guidance Technology Corporation. In 1962, he became corporate vice president for engineering at General Dynamics, where he worked for a dozen years before finally retiring in 1973. Not surprisingly, one of the projects he was involved in at General Dynamics was developing the prototype for what became the Air Force's F–16 Fighting Falcon. Although the aircraft evolved into an all-weather, multi-role fighter, it was originally designed as a lightweight day fighter along the simple, functional lines that characterized Heinemann aircraft.[11]

George A. Spangenberg, aircraft design evaluator, Department of the Navy, 1939–1973. Courtesy, Judith (Spangenberg) Currier.

George A. Spangenberg (1912-2000)

During the years covered by this volume (1945–1960), the Navy normally selected aircraft for development based on paper designs rather than on the performance of prototypes. This practice put a premium on the knowledge and experience of Navy officials involved in the selection process. In this respect, George Spangenberg was without peer.

Born in Duluth, Minnesota, in 1912, Spangenberg attended the University of Michigan, earning a master's degree in aeronautical engineering in 1935. That same year, he began his professional career at the Naval Aircraft Factory in Philadelphia, Pennsylvania, where he worked on a project to convert biplane trainer aircraft to radio-controlled target drones.

In 1939, Spangenberg transferred to the Bureau of Aeronautics in Washington, D.C. For more than three decades, he worked in the bureau's evaluation division, becoming its director in 1957 and continuing in that post in the Bureau of Naval Weapons and Naval Air Systems Command (organizational descendants of the Bureau of Aeronautics) until his retirement in 1973. The division's principal tasks were to coordinate the design requirements for naval aircraft, conduct design competitions, and recommend the best proposals for development.

During Spangenberg's service in the evaluation division, the Navy acquired some of the most successful aircraft in its history. He was heavily involved in recommending the selection of the Chance Vought F8U (later F–8) Crusader day fighter; the McDonnell F4H (later F–4) fighter-bomber; the variable-sweep wing Grumman F–14 Tomcat air-superiority fighter; Lockheed's maritime patrol and antisubmarine warfare aircraft, the land-based P–3 Orion and the carrier-based S–3 Viking; the carrier-based command and control Grumman E–2 Hawkeye; and the Marine Corps heavy-lift Sikorsky CH–53E Super Stallion helicopter. When he died in 2000, almost all Navy and Marine Corps aircraft then in service had been chosen for development under his leadership.[III]

In conducting the design competition for the Crusader, the Navy sent out requests for proposals to 15 aircraft manufacturers. By early 1953, 8 manufacturers had responded with a total of 18 design proposals.[155] In May the Bureau of Aeronautics selected Chance Vought's design and in June issued a letter contract (eventually a cost-plus-fixed-fee contract) for 3 experimental aircraft and a static test article.[156]

From the outset, the Navy intended for the Crusader program to follow a concurrent acquisition strategy. In February 1954, the Bureau of Aeronautics contracted with Chance Vought for production tooling that would be ready in time to construct two experimental prototypes and subsequent production units.[157] Although the first flight of the experimental prototype would not take place until March 1955, BuAer, again by letter contracts, ordered 5 aircraft in May 1954 and 235 in October, with the latter a fixed-price-incentive contract. In line with the FIRM plan, the first 35 aircraft were produced at a slow rate—one to four per month in 1956—and all assigned to testing. Thereafter the program deviated from the anticipated FIRM pattern. Fleet delivery began in March 1957—only two years after the Crusader's first flight, but before the testing program was completed and one year less than the three years FIRM allowed for that purpose. At about the same time, the production rate began to increase rapidly to as many as 20 aircraft per month by the fall of 1957.[158]

The entry of F8U–1s into fleet service seemed a triumph for the Navy and its aircraft acquisition process, particularly in view of the pressure then existing to reduce weapon system cycle time.[159] John Glenn, who flew the Crusader while a test pilot at the Naval Air Test Center at Patuxent, Maryland, just before the aircraft went to the fleet, remembered it as "the equal of any land-based plane."[160] Admiral Burke told his flag and general officers that the Crusader "is a superior fighter. It is better than any fighter aircraft the Russians now have."[161] In reviewing the history of the Navy's postwar aircraft acquisition, George Spangenberg, who from the late 1950s until his retirement in 1973 headed the division in the Bureau of Aeronautics (and later in Naval Air Systems Command) that evaluated contractor design proposals, called the F8U–1 a model both for "what a successful airplane development should be" and for "most subsequent Navy procurements."[162]

While the Bureau of Aeronautics and the Navy may have been proud of the capabilities of the F8U Crusader, others, both within and outside the service, were severely critical of the aircraft's procurement strategy. In late 1957, the assistant secretary of the Navy for material appointed a board to examine the adequacy of logistic support for naval aviation.[163] In March 1958, the board reported that such support was "unsatisfactory," particularly with respect to new model aircraft. It portrayed an alarming situation:

> Many planes in the fleet . . . cannot carry out all their assigned combat missions because of absence or malfunctioning of various components of the plane. This

> factor is of transcendent importance and it is possible that the actual combat readiness condition of fleet squadrons equipped with late model aircraft is not generally known or appreciated by higher echelons of command.[164]

The board cited several causes for the situation. One amounted to an indictment of the FIRM plan: "Recent induction into the fleet of new models of aircraft before the planes were fully ready."[165]

Concerning the F8U–1, specifically, the board pointed out that the aircraft had only a 40 percent availability rate, in part attributable to design changes required by deficiencies in subsystems such as its fire control system and communications package that had been installed before their development was complete.[166] Only the 135th production aircraft, noted the board, would be fully fleet-configured; previous aircraft in the production run would require extensive modification. "The present practice of accepting production run aircraft, non-fleet configured," it opined, "appears to be a costly method of doing business."[167]

Outside the Navy, the government's General Accounting Office (GAO) was a persistent critic of concurrency. In reports issued in 1960 and 1961, it charged that the FIRM plan's key provision—delaying quantity production until testing had demonstrated the system was fleet ready—"is not followed in actual practice."[168] The consequences, in its view, were aircraft that did not perform as expected and required costly modifications that might have been avoided had the Navy not accelerated production prematurely. To solve the problem, the GAO recommended that the Navy pursue "limited development" of several designs before settling on one.[169]

In response, the Bureau of Naval Weapons argued that taking the time to explore multiple designs would delay advanced systems needed by the fleet.[170] The FIRM plan was the best way to avoid this:

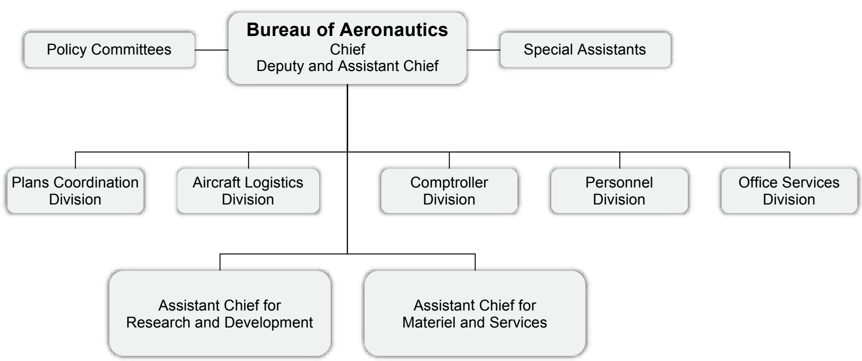
> Even though the early production aircraft are less than perfect, if they are superior to other available systems, production must be accelerated on a timely basis to make them available to the fleet as soon as feasible. As usage reveals areas where improvements are required, modification programs are established to incorporate the changes. Although the FIRM plan of production minimizes the need for modification programs, it does not eliminate them. . . . This is part of the price that must be paid in order to have an inventory ready of the most capable systems in each category.[171]

But whatever the merits of the GAO's or the Navy's position regarding concurrency's efficacy, a debate that would continue in acquisition circles for decades, the word "usage" in the Navy's characterization of the FIRM plan reflected a subtle shift in emphasis. When rolled out in 1955, FIRM's selling point was that, while production would begin before development was complete, system deficiencies would be found during testing and corrected prior to fleet deployment. Five years later, however, the Navy argued that "[m]ost of the necessary modifications can be discovered only by the intensive types of flying which take place [in testing programs] *and in actual fleet usage*."[172]

The Bureau of Aeronautics and the Weapon System Concept

By the mid-1950s, the Navy was beginning to embrace the idea of a weapon system and the weapon system concept of development. In 1955, Admiral Burke signed an instruction, accompanied by an illustrated pamphlet for service-wide distribution, that standardized the definition of the term weapon system: "A naval weapon system encompasses the weapon or weapons and the equipment employed to bring the destructive power of the weapon against the enemy."[173] Additionally, in early 1956 much of the testimony before and the report of the Libby Board dealt with organizing, planning for, and developing new weapons using a systems approach.[174] Then in the Polaris program, with its centralized planning and direction, project-type structure (the Special Projects Office), and concurrency, the Navy successfully executed the concept.

BUREAU OF AERONAUTICS
1954



Source: Adapted from charts in folder (BuAer Organization Charts), box 1, entry 178 (Printed Organization Charts and Function Statements), RG 72.

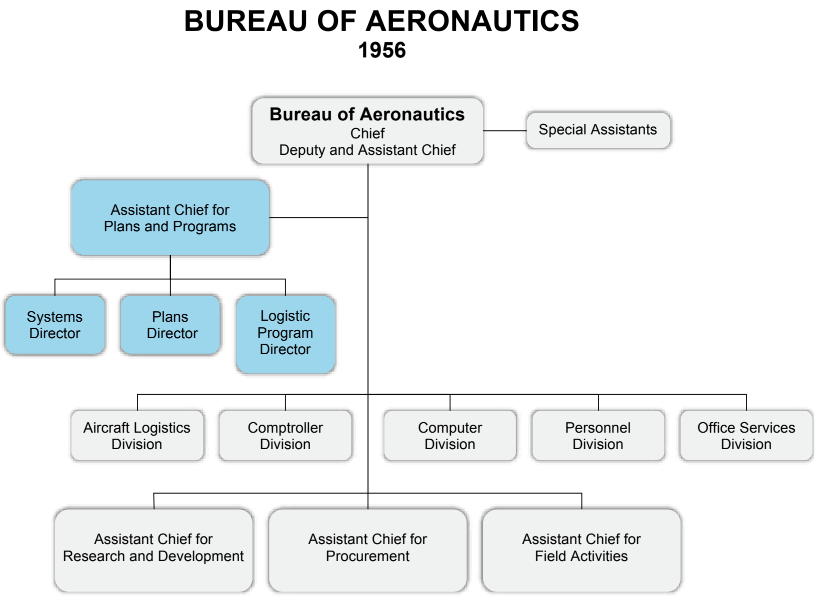
Despite the Polaris success, the Navy did not apply the weapon system approach throughout the service before the end of the 1950s. Several factors slowed its more widespread use. The quasi-independent bureaus posed a formidable obstacle to the centralized planning and coordination that it demanded, and the organizational and procedural adjustments made to the bureau structure that were designed to achieve systems integration largely failed. Combining a vertical organizational pattern with an in-place horizontal and functional structure, even within a bureau, also proved difficult. Furthermore, the Navy's extensive in-house development and production capabilities worked against assigning industry a greater role in weapons programs in at least two of the bureaus. Thus, Bureau of Ships' architects designed the Navy's ships that were built either in government or private yards according to those plans, and the Bureau of Ordnance developed many of its own prototypes and exercised close supervision of its contractors.

The highly successful Sidewinder missile—conceived, designed, prototyped, and tested entirely within BuOrd—is perhaps the best-known example during this period. Industry was left to mass produce the system.[175] In a 1970 study, Booz, Allen & Hamilton pointed out that "[a]ssignment of overall technical and management responsibility to a single prime contractor for development of a total system was foreign to the operating concepts of both BuOrd and BuShips."[176]

Of the three bureaus, the Bureau of Aeronautics was the most receptive to the weapon system approach and gradually adopted or experimented with its major elements during the 1950s. Concurrency, as we have seen, became the norm in BuAer's aircraft acquisition programs early in the Korean War and official policy under the FIRM plan in late 1954. The bureau, albeit cautiously, also sought to organize itself to provide for a greater degree of systems planning and coordination of its weapons development programs, and to expand industry's role in managing them.

Before the end of the Korean War, some officers in the Bureau of Aeronautics began to argue that program planning should employ a systems approach and that the bureau should be organized along those lines.[177] In 1955, BuAer took a small step in this direction by establishing the position of assistant chief for plans and programs. Organizationally equivalent to the bureau's functional chiefs, such as the assistant chief for research and development, the new assistant chief's mission was to improve program planning and execution. In the assistant chief for plans and programs' Plans and Policy Group, the Office of Systems Director coordinated and directed the implementation of all bureau programs. The office was subdivided according to classes of weapon systems (e.g., fighter aircraft, air-to-air missiles). The arrangement corresponded to the class desk structure in the Research and Development Group. The head of each "class desk" subdivision in the Office of the Systems Director was, in effect, a program manager with responsibility in theory for coordinating a system's acquisition from "cradle to grave."[178]

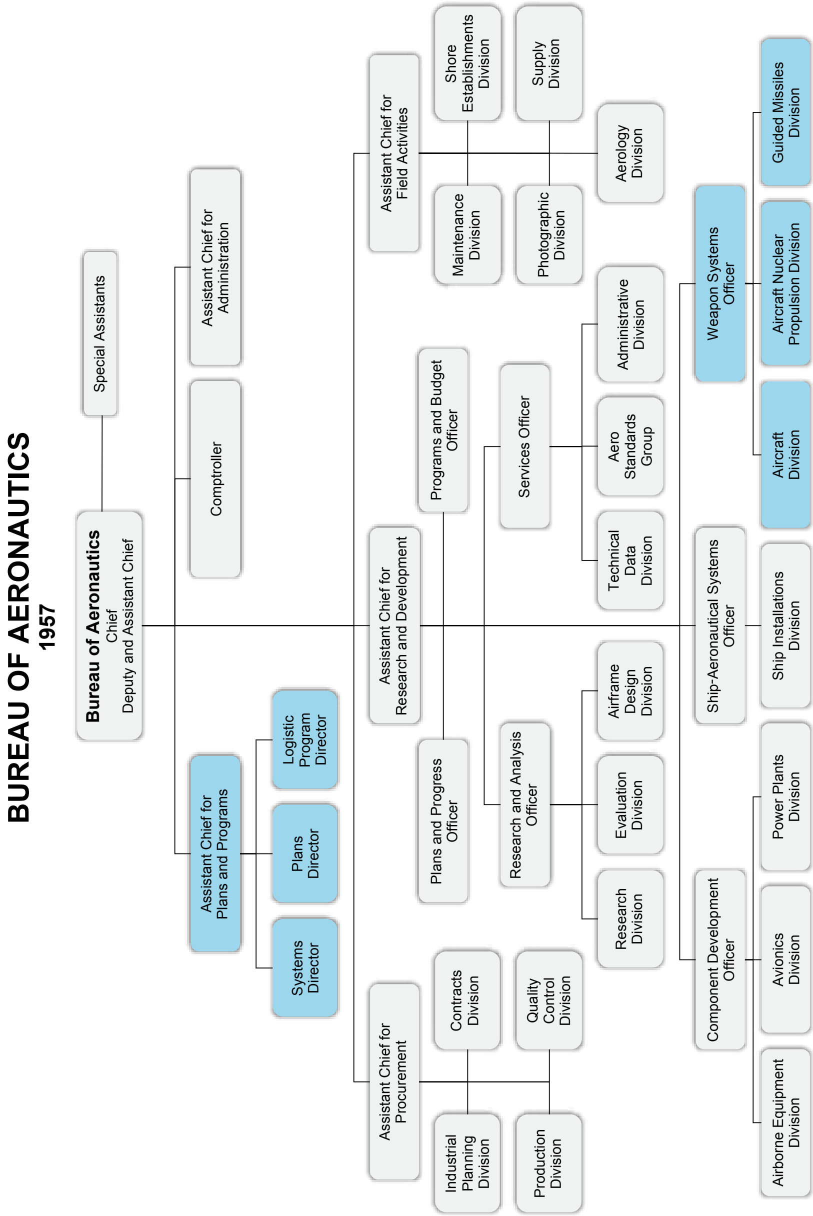
Locating program managers at the assistant chief level would, it was hoped, overcome deficiencies in the bureau's class desk system. Historically, so-called "class desk" officers coordinated an aircraft's or a missile's program execution. By the mid-1950s, the class desk officers were actually branch chiefs in the Research and Development Group's aircraft or missile divisions. Each branch (desk) was responsible for a particular class of aircraft or missile, such as fighter aircraft or air-to-air missiles. Within each branch, project officers had charge of individual aircraft types in that branch's class and reported to the class desk officer.[179] For example, in November 1956, following his tour at the Naval Air Test Center, John Glenn was assigned to the Bureau of Aeronautics as a project officer in the Fighter Design Branch of the Aircraft Division where he was responsible for several versions of the F8U Crusader.[180] The project officers, however, lacked real authority over the systems they had been assigned. According to the chief of the Aircraft Division, the project officer was forced to "go around and pass the hat" within the bureau for subsystems and was in effect "wrapping an airplane around equipments conceivably started three, four, or five years ago, for entirely different objectives or no objective at all."[181]



Source: Adapted from charts in folder (BuAer Organization Charts), box 1, entry 178, RG 72.

The 1955 reorganization did not fulfill its intended purpose. The program managers in the Office of the Systems Director exercised authority only in a system's production phase; the assistant chief for research and development retained principal responsibility through test and evaluation.[182] The latter's project officer continued to be involved in the program once it passed from development to production, but largely as a monitor.

In late 1956, in response to the preliminary report of the Robertson committee recommending that program management be strengthened in both the Air Force and Navy as a way to shorten the weapons acquisition cycle, the Bureau of Aeronautics reorganized again. In the Research and Development Group, a weapon systems officer took control of the aircraft and guided missiles divisions. More importantly, the reorganization altered the role of the program managers in the Plans and Programs Group. Under the new scheme, program managers were identified for major systems (six initially). They set program priorities, drew up and administered a master timetable and funding plan for each program, and acted as expediters to keep each program on schedule. The program managers were assisted by research and development, contracts, production, and maintenance project officers from the bureau's functional divisions. These assistants reported to their division heads, not to the program manager, and worked out of their own offices.[183]



Source: Adapted from 11 January 1957 organization chart in folder (BuAer Organization Charts), box 1, entry 178, RG 72.

The 1956 reorganization went well beyond that of the previous year's attempt to superimpose a vertical management pattern on the bureau's horizontal structure, and created friction. In mid-1958, the head of the Aircraft Division, after four years in the bureau, sent a memorandum to BuAer's chief expressing his disappointment at the lack of results from the organizational changes. One of the three factors he cited for the poor outcome was a "conflict in authority and responsibility" between the assistant chief for plans and programs and the assistant chief for research and development. He pointed out that although the assistant chief for research and development was responsible for aircraft design and development, the program managers "deal directly with the contractors and as time passes, act more and more like, and in the place of, Class Desk officers."[184] When the Bureau of Naval Weapons adopted the dual organizational pattern after 1959, similar tensions appeared.[185]

In a study conducted for the Bureau of Aeronautics in 1957, Booz, Allen & Hamilton recognized the program manager concept as "an essential first step in solution of the need for greater coordination and centralization of program authority."[186] It recommended that the bureau extend the combination of vertical program organization and horizontal, functional structure by initiating a pilot test of a project-office arrangement in which a program manager for a particular aircraft system and representatives from the various functional divisions assigned to that system be physically located in one place.[187]

The Bureau of Aeronautics responded positively to Booz, Allen & Hamilton's suggestion. Early in 1958, the bureau formed a "Weapon System Team" for its new attack aircraft, designated the A2F–1 (later the A–6 Intruder). The team was assigned office space and its members (not all were full time) were directed to conduct all business related to the weapon system in that location. Although in charge of the weapon system team, the program manager shared authority with the team's research and development project officer who headed a separate "R&D Project Team" and controlled the design. With respect to funding, the team was responsible for assessing its adequacy and for keeping costs within the program's fiscal plan. Cost increases were to be dealt with by tradeoffs within the plan unless incompatible with meeting the system's performance requirements, in which case the team could request additional funds.[188]

Designed and built by Grumman, the A2F–1 answered the Navy's requirement for a short takeoff and landing, day/night, all-weather attack jet to replace the piston-engine Douglas AD Skyraider used by the Marines for close air support and by the Navy for interdiction. The Bureau of Aeronautics issued requests for proposals in February 1957 and selected the Grumman two-place, twin turbojet design from the eight proposals received in December. Development began in February 1958 with a contract for a full-scale mock-up.[189]

The A2F–1 first flew in April 1960 and joined the fleet early in 1963.[190] In December 1960, Rear Adm. Edward Ruckner, assistant chief for research, development, test, and evaluation in the Bureau of Naval Weapons, commented that "[w]e have done a wonderful job in developing the A2F aircraft in three years. The Russians couldn't have done any better."[191] For some in the bureau, the A2F's early development success validated the project-office concept: "Faster decision-making leads directly to reduced lead time, and the central team location has significantly aided faster decision-making. Grumman's own personnel . . . have testified to that."[192] Even so, strong opposition to expanding project offices to other programs came from high levels in the Bureau of Naval Weapons through the early 1960s.[193]

The A2F program constituted another benchmark in Navy aircraft acquisition. It was the first cost-plus-incentive-fee contract tied to technical performance to be administered by the Navy, a contract instrument that had been introduced by the Air Force in the B–58 program in 1955 (see chap. 9). In March 1959, the Bureau of Aeronautics followed its contract for a full-scale mock-up of the plane with a cost-plus-incentive-fee contract for 4 development aircraft that was valued at $101,701,000. By its terms, Grumman's profit increased or decreased to the extent that it was able to meet or surpass performance requirements, provide accurate and reliable electronic systems, and reduce costs.[194]

Grumman XA2F–1 (later A–6) Intruder, April 1959.
Courtesy, Naval History and Heritage Command.

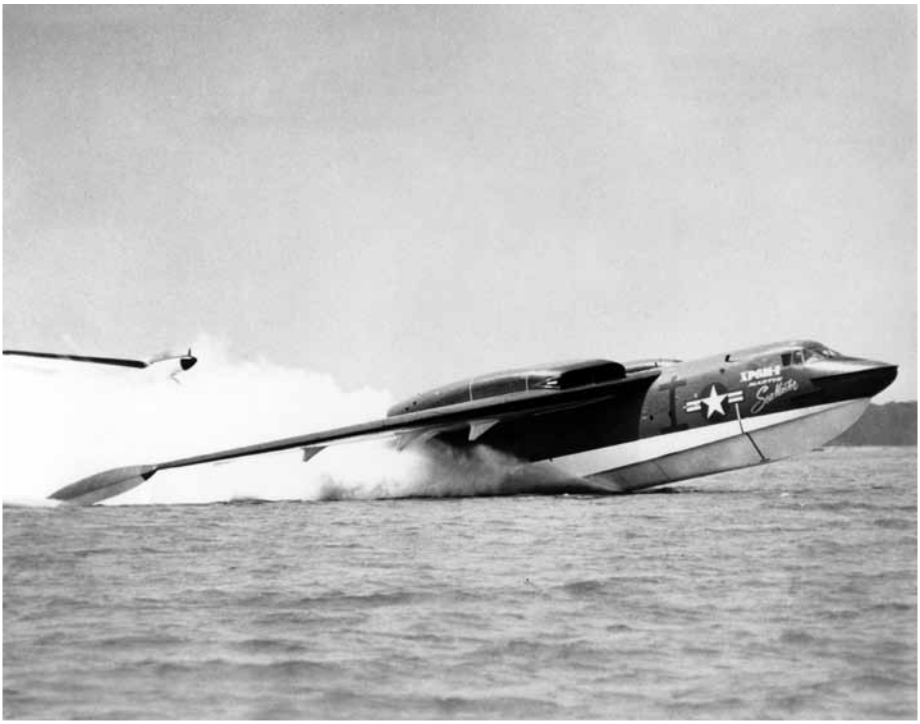
Even more significant than the experiment with a project office or the use of a cost-plus-incentive-fee contract was that the A2F program marked the first time the Bureau of Aeronautics specified that the aircraft manufacturer would also be a single prime contractor, responsible for managing development of every aspect of the system, not just the airframe.[195] Assigning Grumman such sweeping responsibilities was a milestone in the trend, under way in the Bureau of Aeronautics since the early 1950s, to expand industry's role in managing the development of new systems. BuAer's steps in this direction, however, were halting and shadowed by persistent reservations.

At the beginning of the 1950s, the aircraft manufacturer had been responsible for airframe development and for integrating subsystems supplied by the Bureau of Aeronautics as government-furnished-equipment through its contracts with other firms. But during the Korean War, the bureau began to depart from this general acquisition pattern, allowing the airframe manufacturer to acquire some subsystems independently through subcontracts with other firms as contractor-furnished equipment. Two programs, the P6M SeaMaster seaplane and the F4H–1 Phantom II fighter-bomber, illustrate the new approach taken by the bureau.

Development of the P6M SeaMaster, a long-range, four-engine, turbojet seaplane, began in 1952 when the Glenn L. Martin Company, after a design competition, received a contract to build two experimental prototypes. The Navy planned for the aircraft to perform several missions—minelaying, reconnaissance, and high and low altitude attack. In contrast to the standard contract for new aircraft, the Bureau of Aeronautics gave Martin responsibility for procuring subsystems that normally would have been furnished by the government. These included the aircraft's navigation, minelaying, and beaching equipment as well as some of its armament. Notably, Martin was allowed to select the SeaMaster's power plant, the Allison J71 then being developed by the Air Force.[196] On the other hand, Martin's role in managing system development and obtaining subsystems was limited since the Bureau of Aeronautics provided the fire control and communications systems.[197] Moreover, the SeaMaster acquisition was not a deliberate move by the bureau to implement weapon system contracting. The 1957 Booz, Allen & Hamilton study of Navy aircraft procurement noted that the "delegation of responsibility to Martin for weapon system design integration and procurement of major subsystems had not been clearly defined and a common understanding was lacking between BuAer and Martin as to the specific program responsibilities and authority of each."[198] Straining to fund the Polaris and other high-priority weapon systems, the Navy terminated the P6M in August 1959. Only 16 aircraft were built, including the 2 prototypes destroyed in crashes.[199]

In the case of the F4H–1 Phantom II fighter-bomber (later F–4B), another program in which the Bureau of Aeronautics placed more reliance on the aircraft manufacturer, there was no ambiguity regarding the responsibility for system integration. That function was to be performed by McDonnell, the plane's prime contractor.

Gauged by the number produced and length of service, the F–4 Phantom II was probably the most successful U.S. fighter-bomber in the second half of the twentieth century. When production ended in 1979, nearly 5,200 of its different versions had been sold to the Navy, Marine Corps, Air Force, and several foreign countries. Only North American's F–86 Sabre series, built for the Air Force, and the FJ Fury series variant, developed for the Navy, were manufactured in greater numbers. With respect to longevity, the F–4 had no peer. Air Force F–4Gs flew in combat during the first war in Iraq, 1990–1991.[200]



With tail obscured by water spray, Martin XP6M–1 SeaMaster accelerates for takeoff, 1956.

Development of the all-weather, supersonic F–4 began in October 1954 when the Bureau of Aeronautics, in response to an unsolicited design proposal it had received from McDonnell a year earlier, issued a letter of intent to the company for a cost-plus-fixed-fee development contract for two prototypes of a single-seat, twin turbojet, all-weather, cannon and rocket-equipped attack aircraft, designated the AH–1. By the spring of 1955, the bureau had changed plans and, in July, awarded McDonnell a new development contract for a two-seat, twin-turbojet, missile-armed fighter. Designated the F4H–1, the Mach 2–capable fighter would also have a ground-attack capability. This contract covered the two previously ordered prototypes and five preproduction aircraft. Although the F4H–1 Phantom II would not make its first flight until 27 May 1958, in

December 1956, the Navy, following the FIRM plan's low-initial-production-rate policy, ordered 16 more to be used in testing. Two years later, the F4H–1 won a fly-off competition with Chance Vought's single-seat, single-engine F8U–3 Crusader, principally because the Navy preferred the added reliability and safety provided by the F4H–1's two pilots and two engines. Subsequently, the aircraft went into series production. In December 1960, just over six years after development had begun, the F4H–1 entered fleet service.[201]

McDonnell F4H (later F–4B) Phantom II comes in for an arrested landing (note tailhook) on the USS *Forrestal* (CVA–59), February 1962.
Courtesy, Naval History and Heritage Command.

Although the Navy assigned McDonnell the responsibility for system integration in the Phantom II, it did not consider the company to be a "single prime contractor" or "weapon system manager." The Bureau of Aeronautics reserved the latter role to itself. Its contract identified McDonnell as the "principal development contractor," and BuAer's representative at the plant in St. Louis referred to the company as the "airframe coordinator."[202]

As was the norm for Navy aircraft programs in the 1950s, the Bureau of Aeronautics supplied key subsystems for the F4H–1 to McDonnell as government-furnished equipment. These included General Electric's J79 engine, Raytheon's Sparrow III air-to-air missile, Westinghouse's search and track radar, and Lear Instrument's bombing and navigation system. McDonnell's ability to subcontract for components as contractor-furnished equipment was limited to items such as radios, the ejection seat, generators, and pumps that were generally smaller, had relatively short lead times, and could be designed by several firms.[203]

By 1956, the Bureau of Aeronautics was under increasing pressure to expand its use of weapon system contracting. That year the House Subcommittee on Military Operations made such a recommendation in its report on the F3H–1, as did the Robertson committee in its preliminary report on the aircraft acquisition cycle.[204] In commenting on the Robertson committee recommendation, Rear Admiral Russell told the assistant secretary of the Navy for air that "[w]e are open-mindedly going into this, in favor of giving each contractor as much of the complete system as he can handle."[205]

Although increasing the aircraft manufacturer's responsibility in system development, the Bureau of Aeronautics had reservations about doing so and proceeded cautiously. For one thing, subsystems usually lagged well behind the airframe. This convinced some that it made more sense to engage in vigorous subsystem development, especially for engines, and to offer equipment to aircraft manufacturers only when it was ready. For another, if each airframe manufacturer were allowed to acquire subsystems and components unique to its aircraft, the Navy would be unable to support and maintain the large number and variety that would be the inevitable result. Thus, the service had to seek standardization to the greatest extent possible. Finally, the Bureau of Aeronautics, like the Air Force, was concerned about loss of control over subsystems and components when responsibility for subcontractor supervision belonged to the single prime contractor.[206]

By the end of the 1950s, weapon system contracting had become the usual practice in developing the Navy's aircraft. Even so, the Bureau of Aeronautics (and subsequently the Bureau of Naval Weapons) continued to make key decisions regarding system development, to review the prime contractor's performance, and to arbitrate disputes between the single prime contractor and its subcontractors.[207] The single-prime-contractor method, however, did not spread rapidly to systems developed by the Bureau of Ordnance, even after it merged with the Bureau of Aeronautics in the Bureau of Naval Weapons. Finally, in 1966, the Bureau of Naval Weapons made use of the single prime contractor official policy and, in an indication that former Bureau of Ordnance personnel had resisted the concept, stated that "particular emphasis be given to missile, munitions and mine warfare projects."[208]

* * * * *

During the 1950s, many Navy leaders came to view the existing bureau system as not up to the task of providing advanced weapon systems required by the fleet as rapidly as they were needed. This was particularly true with respect to systems that cut across bureau lines. Some thought that overcoming the weaknesses of the bureaus required fundamental reorganization of the Navy's acquisition structure. But most, notably including Admiral Burke, preferred to keep the bureau system largely intact and reform it through procedural adjustments, moderate organizational change such as the merger of the Bureau of Ordnance and the Bureau of Aeronautics, and by centering more control over acquisition in OPNAV and the secretariat. But, by the start of the new decade, those efforts had not proven effective.

The Special Projects Office, through its successful execution of the weapon system concept, demonstrated that combat-ready, advanced weapons could be delivered rapidly to the fleet. Most, however, believed the Navy could support only a small number of these organizations. Under the established acquisition structure, adoption of the weapon system approach proceeded slowly. Both the semiautonomous and functionally organized bureaus, as well as the Navy's substantial in-house capabilities, inhibited the service's ability to take a systems approach to acquiring new weapons. During the 1950s, only the Bureau of Aeronautics had gone very far in this direction.

Endnotes

1. Gary E. Weir, *Forged in War: The Naval Industrial Complex and American Submarine Construction, 1940–1961*, 263; Wyndham D. Miles, "The Polaris," *Technology and Culture* 4, no. 4 (Fall 1963): 478; and Bureau of Naval Weapons, "Case Study of the Fleet Ballistic Missile Program for the Secretary of the Navy Review of Navy Management Effectiveness," July 1962, 3-4, folder Polaris, 60-68, box 7, BAH Records, OAB, NHC.
2. Quoted in Jeffrey L. Rodengen, *Serving the Silent Service: The Legend of Electric Boat,* 117.
3. Ibid., 116-17; and Bureau of Naval Weapons, "Fleet Ballistic Missile Program," 4.
4. "Polaris Chronology: History of the Fleet Ballistic Missile Weapon System Development Program, 1955–1966," 4, folder Polaris, 60-68, box 7, BAH Records, OAB, NHC [hereafter Polaris Chronology]. The chronology is part of Bureau of Naval Weapons, "Case Study of the Fleet Ballistic Missile Program."
5. In implementing the weapon system approach, the Air Force turned over considerable responsibility for managing systems development to industry. In the Fleet Ballistic Missile program, the Special Projects Office also relied heavily on the private sector but reserved to itself more of the responsibility for systems management than the Air Force.
6. Karl Lautenschlager, "Technology and the Evolution of Naval Warfare," *International Security* 8, no. 2 (Fall 1983): 38-41.
7. Paul R. Schratz, "Robert Bostwick Carney," 247-49, and David Alan Rosenberg, "Arleigh Albert Burke," 280-84, 292-94: both in *The Chiefs of Naval Operations*, ed. Robert William Love, Jr.; and Robert W. Love, Jr., *History of the U.S. Navy,* Vol. II, *1942–1991*, 374-75, 377, 404, 410-14. Love disagrees with Rosenberg's assessment that Burke was an "early critic" of massive retaliation.
8. Semiannual Report of the Secretary of the Navy, January 1 to June 30, 1955, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1955*, 149.
9. Had the program not been cancelled in 1959, the long-range, turbojet-powered Martin P6M SeaMaster seaplane would have been a fourth element in the Navy's strategic nuclear delivery capability. For the P6M, see the final section in this chapter and William F. Trimble, *Attack*

from the Sea: A History of the U.S. Navy's Seaplane Striking Force; and Stan Piet and Al Rathiel, *Martin P6M SeaMaster: The Story of the Most Advanced Seaplane Ever Produced*.
10. Percentages are drawn from the tables in Richard M. Leighton, *Strategy, Money, and the New Look, 1953–1956*, 113, 254, 629; and Robert J. Watson, *Into the Missile Age, 1956–1960*, 32, 100, 153, 320, 358.
11. Love, *History of the U.S. Navy*, 381; Jerry Miller, *Nuclear Weapons and Aircraft Carriers: How the Bomb Saved Naval Aviation,* 99-113, 181, 191-94; and Norman Friedman, *U.S. Aircraft Carriers: An Illustrated Design History*, 397-98, 414. The A–5 proved to be ineffective as a carrier-based strategic bomber for several reasons. It had a poorly designed bomb-delivery system, was difficult to land on a carrier, and was hard to maintain. Also, like the B–58, the A–5 was vulnerable to surface-to-air missiles. By 1964, the Navy had modified the A–5 to perform in a reconnaissance role as the RA–5C (See Miller, 109-13).
12. David K. Stumpf, *Regulus: The Forgotten Weapon*, 95, 110, 124, 134, 151; and Dominic A. Paolucci, "The Development of Navy Strategic Offensive and Defensive Systems," U.S. Naval Institute *Proceedings* 96, no. 5 (May 1970): 211.
13. Love, *History of the U.S. Navy*, 406.
14. John T. Hayward and C. W. Borklund, *Bluejacket Admiral: The Navy Career of Chick Hayward*, 170; Love, *History of the U.S. Navy*, 406; Malcolm Muir, Jr., *Black Shoes and Blue Water: Surface Warfare in the United States Navy, 1945–1975*, 93; and Jan S. Breemer, *U.S. Naval Developments*, 24.
15. Stumpf, *Regulus*, 59-60; and Weir, *Forged in War*, 236-37.
16. Stumpf, *Regulus*, 74-76; Muir, *Black Shoes*, 95; Weir, *Forged in War*, 242-43; Love, *History of the U.S. Navy*, 409; and Paolucci, "Navy Strategic Offensive and Defensive Systems," 211. Following the cancellation of Regulus II, the Navy let cruise missile technology languish for more than a decade. (The last Regulus I was withdrawn from fleet service in 1964.) Admiral Elmo R. Zumwalt, Jr., chief of naval operations from 1970 to 1974 and from the surface Navy, blamed "carrier admirals" for the neglect of cruise missiles in what he called the Navy's "single worst decision about weapons . . . during my years of service." (It should be noted that Admiral Burke, also from the surface Navy, made the decision to cancel Regulus.) In the 1970s, General Dynamics developed for the Navy what became the Tomahawk Sea-Launched Cruise Missile (later Land Attack Missile) that was employed in combat for the first time during the Persian Gulf War in 1991. Zumwalt quoted in Breemer, *U.S. Naval Developments*, 9. See also Muir, *Black Shoes*, 96.
17. Polaris Chronology, 4; and Paolucci, "Navy Strategic Offensive and Defensive Systems," 215.
18. Richard G. Hewlett and Francis Duncan, *Nuclear Navy, 1946–1962*, 217. The concept of a nuclear-powered submarine had been first proposed in 1939 by Ross Gunn, a physicist at the Naval Research Laboratory, and was brought to fruition by Rear Adm. Hyman Rickover after the war. For Rickover's role, see Hewlett and Duncan, *Nuclear Navy*, passim; and Francis Duncan, *Rickover and the Nuclear Navy: The Discipline of Technology*.
19. Willis C. Barnes, "Korea and Vietnam," in *Naval Engineering and American Seapower*, ed. Randolph W. King, 294-96; and Love, *History of the U.S. Navy*, 403-44.
20. Graham Spinardi, *From Polaris to Trident: The Development of U.S. Fleet Ballistic Missile Technology*, 39-50; T. A. Heppenheimer, "Heating Up the Cold War," *American Heritage of Invention and Technology* 8, no. 2 (Fall 1992): 27-28; Miles, "Polaris," 484-86; and W. F. Raborn, Jr., "Management of the Navy's Fleet Ballistic Missile Program," in Fremont E. Kast and James E. Rosenzweig, *Science, Technology, and Management*, 142-43.
21. Spinardi, *Polaris to Trident*, 27-31; Weir, *Forged in War*, 246-48; Hewlett and Duncan, *Nuclear Navy*, 309; Harvey M. Sapolsky, *The Polaris System Development: Bureaucratic and Programmatic Success in Government*, 28-34; Miles, "Polaris," 480-82; and Norman Polmar, "Polaris: A True Revolution, U.S. Naval Institute *Proceedings* 132, no. 6 (June 2006): 32.
22. Spinardi, *Polaris to Trident*, 42-50.
23. Paolucci, "Navy Strategic Offensive and Defensive Systems," 215-16; and Norman Polmar,

"Building the United States Fleet, 1947–1967," in *Brassey's Annual: The Armed Forces Year-Book, 1966*, ed. J. L. Moulton, C. N. Barclay, and W. M. Yool, 75.
24. Hewlett and Duncan, *Nuclear Navy*, 371; and Duncan, *Rickover and the Nuclear Navy*, 99-108. Between 1955 and 1975, the U.S. Navy used the term "frigate" to categorize surface warships that displaced more tonnage than destroyers but less than cruisers. See Muir, *Black Shoes*, 57, 229, 248.
25. Muir, *Black Shoes*, 73-77.
26. Rosenberg, "Burke," 276-77.
27. Muir, *Black Shoes*, 75; and Rosenberg, "Burke," 285-86.
28. Confidential Notes of Division Directors' Conference of 22 April 1958, encl. to memo, Chief, Bureau of Aeronautics to Distribution List, 23 April 1958, 7, folder Division Directors' Conference Notes, 1958, box 7, entry 201 (Proceedings and Notes from Division Directors' Meetings), RG 72.
29. Breemer, *U.S. Naval Developments*, 23. These included the *Skate*, *Skipjack*, and *Thresher* classes.
30. Friedman, *U.S. Aircraft Carriers*, 398.
31. Duncan, *Rickover and the Nuclear Navy*, 103; and Polmar, "Building the United States Fleet," 72.
32. Duncan, *Rickover and the Nuclear Navy*, 103-04; Polmar, "Building the United States Fleet," 72-73; and Love, *History of the U.S. Navy*, 417.
33. Love, *History of the U.S. Navy*, 478; and Hewlett and Duncan, *Nuclear Navy*, 376.
34. Duncan, *Rickover and the Nuclear Navy*, 102-07; and Muir, *Black Shoes*, 126, 128. *Long Beach* cost $333 million**.**
35. Muir, *Black Shoes*, 55-57, 62-63.
36. Ibid., 63-67, 99-105.
37. Ibid., 67-68, 83-90, 125. The three classes were *Charles F. Adams* (4,500 tons fully loaded), *Farragut* (6,000 tons), and *Leahy* (8,200 tons).
38. A full-length study of the Naval Tactical Data System is David L. Boslaugh, *When Computers Went to Sea: The Digitization of the United States Navy*. Brief published accounts are David K. Allison, "U.S. Navy Research and Development since World War II," in *Military Enterprise and Technological Change: Perspectives on the American Experience*, ed. Merritt Roe Smith, 320-27; Erick N. Swenson, Edmund B. Mahinske, and Joseph S. Stoutenburgh, "NTDS—A Page in Naval History," *Naval Engineers Journal* 100, no. 3 (May 1988): 53-61; Barnes, "Korea and Vietnam," 290-92; and Muir, *Black Shoes*, 53-55, 98-99.
39. Boslaugh, *When Computers Went to Sea*, 134, 201, 211-13, 215-16, 238-41, 249-58.
40. Rosenberg, "Burke," 265, 266-67, 270, 272-73. Burke attributed his interest in solid propellants for missiles to his graduate work in chemical engineering at the University of Michigan. See interview of Arleigh A. Burke, 12 December 1975, Washington, D.C., 2-3, folder Burke Interview, box 6, Richard D. Leighton materials collected for preparation of *New Look*, deposited with the National Archives and Records Administration; and interview of Arleigh A. Burke by Maurice Matloff, 9 November 1983, Bethesda, Md., 44-45, OSD/HO.
41. Rosenberg, "Burke," 298.
42. Sapolsky, *Polaris System Development*, 21; and Vincent Davis, *The Politics of Innovation: Patterns in Navy Cases*, The Social Science Foundation and Graduate School of International Studies Monograph Series in World Affairs 4, no. 3, 1966–1967, 26-27.
43. E. B. Potter, *Admiral Arleigh Burke: A Biography*, 432.
44. Hewlett and Duncan, *Nuclear Navy*, 265-66.
45. Weir, *Forged in War*, 210-11. Burke is pictured with the Nobska participants at the conference site in Woods Hole, New Hampshire, summer 1956 (Weir, 216).
46. Hewlett and Duncan, *Nuclear Navy*, 266; and Love, *History of the U.S. Navy*, 417.
47. Muir, *Black Shoes*, 83-84.
48. Boslaugh, *When Computers Went to Sea*, 1, 2, 121, 148; and Muir, *Black Shoes*, 99. Burke

may have been especially sensitive to the problem of fleet air defense. In 1945, as Rear Adm. Marc Mitscher's chief of staff in Task Force 58 in the Pacific, he not only planned anti-kamikaze tactics but was subject to their attacks. Returning to the United States in the summer of 1945, he headed an anti-kamikaze research detachment at Casco Bay, Maine, prior to his assignment to the Research and Development Division in the Bureau of Ordnance at the end of the year (Boslaugh, 148; and Potter, *Burke*, 240-58).

49. Ltr, Chief of Naval Operations to Vice Admiral R. E. Libby, 6 January 1956, 2, sub: Precept Convening a Board to Study and Report upon the Adequacy of the Bureau System of Organization, 2, folder Libby Board, box 11, entry 176 (Miscellaneous Records Relating to Management and Organization, 1944–1960), RG 72.

50. Memo, Arleigh Burke, Chief of Naval Operations, for Deputy Chief of Naval Operations (Fleet Operations and Readiness), 16 July 1956, sub: Weapons Systems, encl. to memo, Assistant Chief of Research and Development, Bureau of Aeronautics, for All Division Directors, R&D Group, Bureau of Aeronautics, 3 August 1956, sub: Weapons Systems Concept, folder Libby Board, box 3, BAH Records, OAB, NHC.

51. Report of the Committee on Organization of the Department of the Navy, 16 April 1954, ii, 23, 43, folder 040, Navy, 1954, box 9, entry 200B (Office of the Administrative Secretary, Correspondence Control Section, General Correspondence, 1953–1954), RG 330.

52. Bureau of Aeronautics Material for the Naval History Program of Administrative Problems of the Present National Emergency, 1 March 1952–31 December 1952, 36, encl. to memo, Chief Bureau of Aeronautics [Rear Adm. Lloyd Harrison, deputy and assistant chief] for Chief of Naval Operations (Op–29), 20 August 1953, folder Miscellaneous Reports and Speeches, 1953–1955, box 1, entry 8 (Bureau of Aeronautics—Correspondence, Reports, and Studies Related to Research and Development), RG 402 (Records of the Bureau of Naval Weapons), Archives II.

53. Ltr, Chief, Bureau of Ordnance [Rear Adm. F. S. Withington], to Chief of Naval Operations, 7 January 1955, sub: Cognizance of Aeronautical Solid Propellant Rocket Motors, folder A3/1, 1-1-55, box 6, entry 1009 (General Correspondence, Unclassified and Confidential, 1948–1959), RG 74 (Records of the Bureau of Ordnance), Archives II; ltr, Chief, Bureau of Ordnance and Chief, Bureau of Aeronautics to Chief of Naval Operations, 21 January 1955, sub: Aircraft Fire Control Cognizance, folder A3/1, 1-1-55, box 22, entry 1008 (General Correspondence, Unclassified and Confidential, 1948–1959, Unclassified 1955), RG 74; ltr, Chief, Bureau of Aeronautics [Rear Adm. Lloyd Harrison, acting chief] to Chief of Naval Operations, 3 February 1955, sub: Cognizance of Aeronautical Solid Propellant Rocket Motors, folder A3/1, 1-1-55, box 6, entry 1009, RG 74; memo, Chief of Naval Operations [Admiral Robert B. Carney] for Secretary of the Navy [Charles S. Thomas], 14 May 1955, sub: Unresolved Problem of Cognizance between the Bureau of Ordnance and Bureau of Aeronautics Regarding Aircraft Fire Control and Aeronautical Solid Propellant Rocket Motors, folder A3 Organization and Management, box 2, Op–00 Files (1955), OAB, NHC; and memo, Chief of Naval Operations for Chief, Bureau of Ordnance and Chief, Bureau of Aeronautics, 1 July 1955, sub: Unresolved Problem of Cognizance between the Bureau of Ordnance and Bureau of Aeronautics Regarding Aircraft Fire Control and Aeronautical Solid Propellant Rocket Motors, enclosing ltr, Chief of Naval Operations to Chief, Bureau of Ordnance and Chief, Bureau of Aeronautics [same subject, same date] and Secretary of the Navy 1st endorsement, 30 June 1955 [same subject] on CNO ltr of 14 May 1955 [same subject], folder A3 Organization and Management, box 2, Op–00 Files (1955), OAB, NHC.

54. Ltr, Chief, Bureau of Aeronautics [Rear Adm. James S. Russell], to Chief of Naval Operations [Admiral Robert B. Carney] via Chief, Bureau of Ordnance, 5 August 1955, sub: Proposed Changes in Articles 0425, 0420, 0427, 0435 and 0445.1, U.S. Navy Regulations, folder A3 Organization and Management, box 2, Op–00 Files (1955), OAB, NHC.

55. Memo, Chief of Naval Operations [Admiral Arleigh Burke] for Secretary of the Navy [Charles S. Thomas], 3 September 1955, sub: Bureau Cognizance in the Field of Guided Missiles enclosing Report of Ad Hoc Committee, folder Brochure on Cognizance of Weapon

Development, box 3, Op–00 Files (1957), OAB, NHC.
56. Ltr, Assistant Secretary of the Navy for Air [J. H. Smith, Jr.] to Secretary of the Navy, 6 October 1955, sub: Bureau Cognizance in the Field of Guided Missiles, folder Brochure on Cognizance of Weapon Development, box 3, Op–00 Files (1957), OAB, NHC.
57. Memo, Arleigh Burke for Secretary of the Navy, 10 October 1955, sub: Bureau Cognizance in the Field of Guided Missiles, folder Brochure on Cognizance of Weapon Development, box 3, Op–00 Files (1957), OAB, NHC.
58. Memo, Chief, BuAer for CNO, 12 October 1955, sub: Cognizance of Guided Missiles—BuOrd and BuAer, folder A3, Organization and Management, box 2, Op–00 Files (1955), OAB, NHC. Burke's 10 October assertion to the secretary of the Navy regarding bureau chief unanimity was false. Rear Admiral Russell noted in his 12 October memorandum for the CNO that he had called on him on either 5 or 6 October (date not certain because the handwriting in Russell's memorandum is blurred) and stated his opposition to the new policy. Burke quickly informed the secretary of the Navy that his statement about the position of the bureau chiefs was not correct and that, in fact, Russell did not concur with the proposal. See memo, Burke for Secretary of the Navy, 14 October 1955, sub: Bureau Cognizance in the Field of Guided Missiles, folder Brochure on Cognizance of Weapon Development, box 3, Op–00 Files (1957), OAB, NHC.
59. Davis, "The Politics of Innovation," 23-26. According to Davis, Admiral Carney sought to limit BuAer's work on ballistic missiles because costs would be too high and, until they were proven, ballistic missile development would have to draw on funds committed elsewhere. The chief of naval operations also thought the required technologies (i.e., compact nuclear warhead; guidance, fire control, navigation, and launch systems; and adequate solid propellant) were not yet available nor was it certain that they would be. Rear Adm. H. D. Felt, then assistant chief of naval operations for fleet readiness, gave most of the credit for taking advantage of the Killian panel's recommendations regarding a sea-based ballistic missile to Assistant Secretary Smith: ". . . the Killian Committee opened the door for the Navy in this business. The Navy did not seem inclined to give it a kick and proceed and he [Smith] insisted that the Navy do it." See testimony of Rear Adm. H. D. Felt before the Board to Study and Report upon the Adequacy of the Bureau System of Organization, 25 January 1956, 56-57, box 19, Op–00 Files (1956), OAB, NHC.
60. Sapolsky, *Polaris System Development*, 16, 20, 62-63.
61. Testimony of Rear Adm. J. H. Sides before the Libby Board, 30 January 1956, 7-8, box 19, Op–00 Files (1956), OAB, NHC.
62. Testimony of Assistant Secretary of the Navy for Air James H. Smith, Jr., before the Libby Board, 3 February 1956, 21, box 20, Op–00 Files (1956), OAB, NHC.
63. Testimony of Under Secretary of the Navy Thomas S. Gates, Jr., before the Libby Board, 24 January 1956, 11, box 18, Op–00 Files (1956), OAB, NHC. After a presentation by Rear Admiral Sides to Robertson on the Navy's missile programs (attended by Thomas, Smith, and Burke) in October, Sides noted that Robertson appeared to have decided against an independent role for the Navy in IRBM development. See memorandum for record, Rear Adm. J. H. Sides, Director, Guided Missiles Division, Op–51, Office of the Chief of Naval Operations, 11 October 1955, sub: Navy Guided Missile Presentation to the Deputy Secretary of Defense, folder A20, Boards, Committees, and Commissions, box 5, Op–00 Files (1955), OAB, NHC. See also Davis, "Politics of Innovation," 26; and Sapolsky, *Polaris System Development*, 20-21.
64. Leighton, *New Look*, 443.
65. Testimony of Under Secretary Thomas S. Gates, Jr., before the Libby Board, 24 January 1956, 9, 11-12; and Sapolsky, *Polaris System Development*, 62-63.
66. Polaris Chronology, 4; and Spinardi, *From Polaris to Trident*, 37.
67. Bureau of Naval Weapons, "Fleet Ballistic Missile Program," 1-2, 29-30.
68. Quoted in Spinardi, *From Polaris to Trident*, 25.
69. "The Extension of Special Organizational Patterns and Management Techniques to

Additional Weapon Systems," January 1962, 2: 3, 4, 9, 13-14; 3: 7-10 (Study prepared for the Assistant Secretary of Defense, Installations and Logistics by United Research Incorporated, Cambridge, Mass.) [hereafter United Research study]; Bureau of Naval Weapons, "Fleet Ballistic Missile Program," 2, 21, 26, 30, 36-41; and Sapolsky, *Polaris System Development*, 69.

70. Sapolsky, *Polaris System Development*, 63, 88 (note 47).

71. United Research study, 2: 3. After its creation, the Special Projects Office set up a field office at the Army Ballistic Missile Agency to coordinate with the Army in the Jupiter program. After separation from the joint Army-Navy program, the SPO began to establish field offices at contractor sites.

72. Bureau of Naval Weapons, "Fleet Ballistic Missile Program," 23.

73. Ibid., 21-22.

74. Ltr, Chief of Naval Operations to Secretary of the Navy, 10 November 1955; and ltr, Secretary of the Navy to Chief, Bureau of Ordnance, 17 November 1955: both in folder Brochure on Cognizance of Weapon Development, box 3, Op–00 Files (1957), OAB, NHC.

75. Bureau of Naval Weapons, "Fleet Ballistic Missile Program," 26; and Sapolsky, *Polaris System Development*, 57, 69.

76. Testimony of Rear Adm. William F. Raborn, Jr., before the Libby Board, 25 January 1956, 4, box 19, Op–00 Files (1956), OAB, NHC.

77. Bureau of Naval Weapons, "Fleet Ballistic Missile Program," 26. See also Weapons Acquisition Research Project, Graduate School of Business Administration, Harvard University, unpublished draft of "A Case Study of Polaris: Top Priority Long-Range Ballistic Missile Development," n.d. but ca. 1959–1960, II: 4-5. Copy provided to author by Frederic M. Scherer.

78. Sapolsky, *Polaris System Development*, 79-81. The principal private subsystem contractors for the Fleet Ballistic Missile system were missile (Lockheed); propulsion (Aerojet General); launch and handling (Westinghouse); fire control and guidance (General Electric, Massachusetts Institute of Technology); navigation (Sperry Rand, Autonetics, and The Johns Hopkins University Applied Physics Laboratory); test instrumentation and operation (Interstate Electronics, Lockheed); and submarine (Electric Boat Division, General Dynamics). See Weapons Acquisition Research Project, Graduate School of Business Administration, Harvard University, draft "Case Study of Polaris," II: 6; Sapolsky, 95 (chart); and Weir, *Forged in War*, 246-47.

79. Sapolsky, *Polaris System Development*, 87.

80. Ibid., 89-91.

81. Bureau of Naval Weapons, "Fleet Ballistic Missile Program," 30-31; William F. Whitmore, "The Origin of Polaris," U.S. Naval Institute *Proceedings* 106, no. 3 (March 1980): 57; Sapolsky, *Polaris System Development*, 73, 154, 206, 238; and Spinardi, *From Polaris to Trident*, 36-38.

82. Sapolsky, *Polaris System Development*, 99-100.

83. Bureau of Naval Weapons, "Fleet Ballistic Missile Program," 62-64.

84. Sapolsky, *Polaris System Development*, 103, 106-08 (quotation, 106), 110-24, 181-82. For an analysis of PERT and a more detailed discussion of Polaris development, see Volume II in the series, *History of Acquisition in the Department of Defense (*forthcoming).

85. Testimony of Rear Adm. Raborn before the Libby Board, 25 January 1956, 4.

86. Testimony of Rear Adm. Rawson Bennett II before the Libby Board, 20 January 1956, 39, box 18, Op–00 Files (1956), OAB, NHC.

87. Tab A, 24, Minutes of the Ninth Meeting of the Defense Science Board, 10–11 September 1958, box 834, Subject Files (Research and Development, 1953–1960), OSD/HO. In addition to the Special Projects Office, there were only three other project office-type organizations in the Navy between 1945 and 1960. Two were in BuShips—Rear Admiral Rickover's joint venture with the Atomic Energy Commission to build a nuclear-powered submarine, and the Naval Tactical Data System project office. The other, to be described later in the chapter, was established for the A2F attack aircraft program in BuAer in 1958.

88. Ltr, Burke to Libby, 6 January 1956, 1.

89. According to Admiral Raborn, "the fact that a project like mine has been set up is the biggest indictment of the bureau system we know of. . . ." See testimony of Rear Adm. Raborn before the Libby Board, 25 January 1956, 2.
90. Testimony of Under Secretary Gates before the Libby Board, 24 January 1956, 3.
91. In all, 68 witnesses appeared before the board. Verbatim transcripts of the testimony of each witness, along with the Libby Board's report, are available in boxes 17-21, Op–00 files (1956), OAB, NHC. They provide a unique, first-hand, high-level look at Navy acquisition in the mid-1950s. Like retired Air Force generals, the Navy's admirals moved easily into industry after their retirement. The following retired flag officers (corporate affiliations in parentheses) testified before the board: Admiral R. B. Carney, former CNO (Westinghouse); Vice Adm. G. F. Hussey, Jr., former chief, BuOrd (president, American Ordnance Association); Vice Adm. E. W. Mills, former chief, BuShips (president, Foster Wheeler Corporation); Rear Adm. C. M. Bolster, former chief of naval research (General Tire and Rubber Co.); Rear Adm. W. D. Leggett, Jr., former chief, BuShips (vice president for engineering, ALCO); Rear Adm. F. R. Furth, former chief of naval research (assistant to the president, Farnsworth Electronics Co.); Rear Adm. P. F. Lee, former chief of naval research (Gibbs and Cox, Inc.); Rear Adm. L. B. Richardson, former deputy and assistant chief, BuAer (executive vice president, General Dynamics Corp.); and Rear Adm. M. F. Schoeffel, former chief, BuOrd (General Precision Equipment Co.).
92. Testimony of Rear Adm. Sides before the Libby Board, 30 January 1956, 16. For other examples of bureau coordination problems with Regulus, see testimony of Rear Adm. H. D. Baker, commander Operational Development Force, 1 February 1956, 11-16, box 19; testimony of Rear Adm. J. E. Clark, Op–51, OPNAV, 18 January 1956, 11, box 18; and testimony of Capt. A. B. Metsger, director, Guided Missiles Division, BuAer, 6 February 1956, 14-16, box 20.
93. Testimony of Rear Adm. Bennett before the Libby Board, 20 January 1956, 63.
94. Testimony of Rear Adm. Sides before the Libby Board, 30 January 1956, 16-18. For this and other instances of coordination problems with Sparrow I between the bureaus and other government agencies, see testimony of Capt A. B. Metsger, 6 February 1956, 16-18; testimony of Rear Adm. J. S. Russell, chief, Bureau of Aeronautics, 19 January 1956, 54-55, box 18; and testimony of Rear Adm. W. A. Schoech, assistant chief for R&D, BuAer, 19 January 1956, 7-8, box 18.
95. Testimony of Vice Adm. M. E. Curts, deputy commander-in-chief Pacific Fleet, before the Libby Board, 17 February 1956, 6, box 21.
96. See, for example, the testimony of Assistant Secretary Smith before the Libby Board, 3 February 1956, 7; testimony of Rear Adm. Russell, 19 January 1956, 9; testimony of Rear Adm. Schoech, 19 January 1956, 9; and testimony of Capt. Metsger, 6 February 1956, 19, 20-23. One non-aviator, Rear Adm. C. D. Griffin, director of the newly established Long Range Objectives Group (Op–93) in OPNAV, thought that "it might be a good idea" to merge BuOrd and BuAer. See testimony of Rear Adm. C. D. Griffin, 27 January 1956, 64, box 19. Rear Admiral Russell suggested presciently that a bureau combining the two bureaus be called the Bureau of Naval Weapons (Schoech testimony).
97. See, for example, the testimony of Assistant Secretary of the Navy (Material) Raymond H. Fogler before the Libby Board, 2 March 1956, 2-3, 5, box 21; testimony of Adm. D. B. Duncan, vice chief of naval operations, 24 January 1956, 23-24, box 18; testimony of Vice Adm. R. P. Briscoe, deputy chief of naval operations for fleet operations and readiness, Op–03, OPNAV, 19 January 1956, 79-80, 83-85, 91, box 18; testimony of Vice Adm. Curts, 17 February 1956, 2, 16-17; testimony of Rear Adm. Clark, 18 January 1956, 21-22; testimony of Rear Adm. Furth, 15 February 1956, 2-3, box 21; testimony of Rear Adm. W. K. Mendenhall, Op–43, 23 January 1956, 46-47, box 18; testimony of Rear Adm. A. G. Mumma, chief, BuShips, 18 January 1956, 6, 10-11, box 18; testimony of Rear Adm. Sides, 30 January 1956, 18-22; and testimony of Rear Adm. F. S. Withington, chief, BuOrd, 24 January 1956, 56, box 18.
98. Admiral Libby, perhaps reflecting Admiral Burke's previously stated opposition to reorganization, strongly defended the status quo throughout the hearings. See, especially,

his lengthy comments during the testimony of retired Vice Adm. E. W. Mills, former chief, BuShips, 16 February 1956, 11-14, box 21. Libby could not restrain himself during Assistant Secretary Smith's appearance. Secretary Smith: "I realize that this [the organizational problem] is not something that is easily solved." Admiral Libby: "I am glad you realize that, sir." See testimony of Assistant Secretary Smith, 3 February 1956, 26.

99. Report of the Board Convened by the Chief of Naval Operations to Study and Report upon the Adequacy of the Bureau System of Organization [hereafter Libby Board report], 14 March 1956, I: 1; III: 22-23, encl. to ltr, Libby Board to Chief of Naval Operations, 14 March 1956, sub: Report of the Board, folder Libby Board, box 11, entry 176, RG 72.

100. Ibid., III: 1-6.

101. Ibid., II: 2-3; III: 23-24, 32-34.

102. Ibid., II: 2; III: 16-18, 20.

103. Ibid., I: 1; II: 1-2; III: 7-16, 18-20; Chief of Naval Operations to Distribution List, 29 January 1957, OPNAV Notice 05201 (Implementation of Certain Recommendations of the Board to Study and Report upon the Adequacy of the Bureau System of Organization), folder Libby Board, 12/55-2/57, box 2, entry 5 (Management Studies, Administrative and Technological Histories, 1940–1967), RG 402; and Booz, Allen & Hamilton, Inc., *Review of Navy R&D Management, 1946–1973*, Vol. I, 37-39.

104. See ltr, Chief, Bureau of Ships [Rear Adm. A. G. Mumma] to Chief of Naval Operations, 3 April 1956; ltr, Chief, Bureau of Aeronautics [Rear Adm. James S. Russell] to Chief of Naval Operations, 4 April 1956; ltr, Acting Chief, Bureau of Ordnance [Rear Adm. P. D. Stroop] to Chief of Naval Operations, 5 April 1956 (all same sub: Report of the Board to Study and Report upon the Adequacy of the Bureau System of Organization); and ltr, Chief of Naval Research [Rear Adm. Rawson Bennett] to Chief of Naval Operations, 6 April 1956, sub: Libby Board Report: all in folder Libby Board, 12/55-2/57, box 2, entry 5, RG 402.

105. Chief of Naval Operations to Distribution List, 29 January 1957, OPNAV Notice 05201 (Implementation of Certain Recommendations of the Board to Study and Report upon the Adequacy of the Bureau System of Organization).

106. Secretary of the Navy to Distribution List, 1 August 1957, SECNAV Instruction 3900.5 (Lead Bureau Method of System Development; adoption of), folder SecNav Instructions, box 6, BAH Records, OAB, NHC. No evidence was found during the course of the research for this volume that either the Inter-Bureau Technical Group or the Executive Council was ever formed. When asked to comment on the Libby Board's proposal to establish the two bodies, the chief of BuAer and the chief of naval research had criticisms of both. See ltr, Chief, Bureau of Aeronautics [Rear Adm. James S. Russell] to Chief of Naval Operations, 4 April 1956, sub: Report of the Board to Study and Report upon the Adequacy of the Bureau System of Organization; and ltr, Chief of Naval Research [Rear Adm. Rawson Bennett] to Chief of Naval Operations, 6 April 1956, sub: Libby Board Report: both in folder Libby Board, 12/55-2/57, box 2, entry 5, RG 402.

107. Report of the Committee on Organization of the Department of the Navy, 1959 [hereafter Franke Committee report], 102, copy in NDU Library; and Review of Management of the Department of the Navy, Vol. II, Research and Development Management Study, 19 October 1962, 71-72, 85, box 1, entry 5, RG 402. Beginning with the FY 1960 budget submission (and implemented by a memorandum from the assistant secretary of defense, comptroller, in November 1958), each military department's R&D appropriation was expanded to include funds for test and evaluation. See Booz, Allen & Hamilton, *Review of Navy R&D Management*, Vol. I, 280-81.

108. Memo, Rear Adm. F. S. Withington for Rear Adm. J. S. Russell, 25 January 1957, sub: Cognizance of Guided Missiles, folder Brochure on Cognizance of Weapon Development, box 3, Op–00 Files (1957), OAB, NHC.

109. Ibid.

110. Memo, Rear Adm. James S. Russell for Rear Adm. F. S. Withington, 26 January 1957, sub:

Cognizance of Guided Missiles, folder Brochure on Cognizance of Weapon Development, box 3, Op–00 Files (1957), OAB, NHC.
111. Memo, Rear Adm. F. S. Withington for Admiral Burke, 13 February 1957, sub: Cognizance of Weapon Development; recommendations concerning, folder Brochure on Cognizance of Weapon Development, box 3, Op–00 Files (1957), OAB, NHC.
112. Handwritten note from "B" [Burke] to Op–09 [the vice chief of naval operations] on Rear Adm. F. S. Withington memo for Admiral Burke, 7 March 1957, sub: Cognizance of Guided Missiles, folder Brochure on Cognizance of Weapon Development, box 3, Op–00 Files (1957), OAB, NHC. The Withington memo enclosed a long memorandum, dated 20 February 1957, from Rear Adm. P. D. Stroop, the recently reassigned former deputy chief of BuOrd. Stroop had been a member of the Libby Board and had been opposed at that time (and was still opposed) to merging BuOrd and BuAer, but he strongly endorsed the concept of a Bureau of Weapons along the lines Withington had recommended. Stroop, who was also a naval aviator, became the first chief of the Bureau of Naval Weapons in 1959.
113. Memo, Rear Adm. K. M. McManes, Deputy Chief of Naval Operations (Administration), for Chief of Naval Operations, 13 August 1958, sub: Information on Organization, folder A3, Organization and Management, box 3, Op–00 Files (1958), OAB, NHC.
114. Franke Committee report, III, 19.
115. *Naval Weapons Bulletin*, no. 1-60 (January–March 1960), 4, folder Air Systems Command Series: Naval Weapons Bulletin, January–December 1960, box 1078, Post 1 Jan 1946 Command File, OAB, NHC.
116. Franke Committee report, 100-2.
117. Ibid., 104.
118. Ibid., 100.
119. Booz, Allen & Hamilton, *Review of Navy R&D Management*, Vol. I, 56-57.
120. Ibid., 57-58.
121. Franke Committee report, 61. See also Hayward, *Bluejacket Admiral*, 253-54. The committee had not made the same suggestion for the Bureau of Naval Weapons, but the new bureau's organizers attempted to marry a traditional horizontal and functional arrangement with a vertical program management framework. See "Navy's New Research Office," *Armed Forces Management* 5, no. 9 (June 1959): 33-34; Fred Hamlin, " 'More Logical Spending' for Navy's Weapons," *Armed Forces Management* 6, no. 4 (January 1960): 19-21; *Naval Weapons Bulletin*, no. 1-60 (January–March 1960), 1, 3; and Booz, Allen & Hamilton, *Review of Navy R&D Management*, Vol. I, 61-62.
122. Franke Committee report, 102.
123. Ibid, 103.
124. Willis C. Barnes presents an excellent discussion on this aspect of naval acquisition during this period in his "Korea and Vietnam," *Naval Engineering and American Seapower* (1989), 277-317.
125. "Shipborne Electronic Equipment—A Discussion of Present Situation," encl. to memo Capt. Denys W. Knoll, Director, Ship Characteristics Division (Op–42), for Op–04 [deputy chief of naval operations, logistics, and chairman, Ship Characteristics Board], 16 September 1959, sub: Electronics in Navy Ships, folder 5050, Meetings, box 6, Op–00 Files (1959), OAB, NHC. For the difficulties encountered in readying *Galveston* for fleet service, see Muir, *Black Shoes*, 84-85.
126. Department of the Navy, Review of Management of the Department of the Navy, Vol. II, Research and Development Management Study, 19 October 1962, 69, box 1, entry 5, RG 402.
127. Ibid., 72.
128. Richard P. Hallion, *The Naval Air War in Korea*, 116-17, 119-20, 309; and John Glenn, with Nick Taylor, *John Glenn: A Memoir*, 137-38.
129. Ibid., 138-47.
130. Ibid., 193.

131. Bolt blamed this state of affairs on BuAer's alleged practice of accepting inferior aircraft from the Navy's top five manufacturers in order to keep them in business, thereby sustaining a broad expansion base for aircraft production in wartime. See memo, Lt. Col. John F. Bolt for Chief, Bureau of Aeronautics, 27 April 1956, sub: Fighter Plane Procurement, A Voice from the Back Row on, folder FIRM History Working Papers, #4 of 4, box 7, entry 5, RG 402.
132. See chap. 7 in this volume in the acquisition history series. See also Mark A. Lorell and Hugh P. Levaux, *The Cutting Edge: A Half Century of U.S. Fighter Aircraft R&D*, 42 (and note 30), 45, 72.
133. Bureau of Aeronautics Material for the Naval History Program of Administrative Problems of the Present National Emergency, 1 March 1952–31 December 1952, 16-17, encl. to memo, Chief Bureau of Aeronautics [Rear Adm. Lloyd Harrison, deputy and assistant chief] for Chief of Naval Operations (Op–29), 20 August 1953, folder Miscellaneous Reports and Speeches, 1953–1955, box 1, entry 8, RG 402. Among the accelerated fighter and attack aircraft programs were the McDonnell F3H–1 Demon, the Douglas F4D–1 Skyray, the Chance Vought F7U Cutlass, the Grumman swing-wing F10F Jaguar, the Douglas A2D–1 Skyshark, and the Chance Vought A2U–1 (the attack version of the F7U). The F10F (112 ordered, none delivered, program cost $33 million), A2D–1 (341 ordered, 6 delivered, program cost $92 million), and A2U–1 (96 ordered, none delivered) were cancelled. Both the McDonnell F3H (as the F3H–2) and the Chance Vought F7U–3 entered fleet service but were not considered to be successful. John Glenn, who served as a test pilot at the Naval Air Test Center at Patuxent River, Maryland, in the mid-1950s and flew the aircraft, described the F7U Cutlass as "an innovative but flawed plane." (Glenn, *John Glenn*, 159). In contrast, despite delays in development, the F4D Skyray performed successfully once it reached the fleet. See also Press Release No. 1130-54 (Aircraft Contracts Cancelled by Navy), Office of Public Information, Department of Defense, 19 November 1954, folder Aircraft 1955, box 854, Subject Files (Research and Development, 1953–1960), OSD/HO; Statement of Secretary of the Navy Charles S. Thomas Regarding the Navy Air Procurement Program before the Special Investigating Subcommittee of the House Armed Services Committee, 4 February 1955, 3-6, folder FIRM History Working Papers, #3 of 4, box 7, entry 5, RG 402; Surveys and Investigations Staff, House of Representatives Committee on Appropriations, *A Report to the Committee on Appropriations, U.S. House of Representatives on Procurement Policies and Practices, Department of Defense*, January 1956, 148-50 (F10F), 152-54 (A2D), 157-59 (F3H), and 161-62 (F7U/A2U), box 2, entry 160A (Assistant Secretary of Defense, Supply and Logistics, Secret Files, 1956), RG 330 [hereafter Procurement Policies and Practices report]; memo, Rear Adm. Ralph E. Wilson, Director, General Planning Group (Op–90), for Chief of Naval Operations, 3 February 1956, sub: Procurement Policies and Practices, folder BuAer, Procurement, Aircraft, box 10, entry 46 (Records Relating to Production of Naval Aircraft), RG 343 (Records of the Naval Air Systems Command), Archives II; General Accounting Office, Comptroller General of the United States, *Review of Aircraft Procurement Programs in the Department of the Navy*, Pt. I [includes a scathing indictment of the acquisition of the F7U Cutlass, 7-8, 33-47], February 1960, folder GAO Aircraft Procurement Programs in Navy, 1960, box 10, entry 46, RG 343; and Lorell and Levaux, *Cutting Edge*, 45, 48, 72-73.
134. Address by Adm. Arthur W. Radford, Chairman, Joint Chiefs of Staff, before the 1957 Secretaries' Conference, Quantico, Virginia, 15 June 1957, folder Subjects: Eisenhower Document File I, box 20, entry A1, 40200-D (Records of the President's Blue Ribbon Commission on Defense Management, 1985–1986; Records of the Deputy Director and General Council, Subject File), RG 220 (Records of Temporary Commissions, Committees, and Boards), Archives II.
135. The reason for the change was that Douglas' F4D–1 Skyray, also under development, looked as though it would be a better interceptor than the F3H, while development of Grumman's F10F, intended to be a general purpose fighter, was not progressing satisfactorily and the Navy needed a highly capable general purpose fighter in Korea. See statement of Rear Adm. James S. Russell, House Committee on Government Operations, *Navy Jet Aircraft*

Procurement Program: Hearings before a Subcommittee of the Committee on Government Operations, 84th Cong., 1st sess., October 24, 25, 26, and 27, 1955, 28 [hereafter Russell statement].

136. Russell statement, 28; House of Representatives, Tenth Intermediate Report of the Committee on Government Operations, *Navy Jet Aircraft Procurement Program*, 84th Cong., 2d sess., 14 March 1956, H. Rpt. 1891, 8-9 [hereafter Tenth Intermediate Report]; and Thomas A. Marschak, *The Role of Project Histories in the Study of R&D*, 41.

137. Russell statement, 28-30; Tenth Intermediate Report, 10-16; and Marschak, *Project Histories*, 41-42.

138. Like its J40 equipped predecessor, the F3H–2 with the Allison J71 was also considered to be underpowered, and according to one naval historian, "at best a second-rate aircraft." Even so, the Demon was the Navy's principal all-weather interceptor until its successor, McDonnell's famous F4H–1 Phantom II, began to enter fleet service in late 1960. For the F3H–2 Demon, see Jerry O'Rourke, "Fighters That Never Got to the Fight: Part II," U.S. Naval Institute *Proceedings* 108, no. 4 (April 1982): 75-79; "McDonnell F3H (F3) Demon," in René J Francillon, *McDonnell Douglas Aircraft since 1920*, Vol. II, 121-27; and Norman Polmar, "The Demon That Could Hardly Fly: McDonnell F3H Demon," in *Historic Naval Aircraft*, 31-34 (quotation, 31).

139. Tenth Intermediate Report, 4, 39; and Polmar, *Historic Naval Aircraft*, 31.

140. Procurement Policies and Practices report, 159.

141. The figure included $79.5 million in contract termination costs for the engines, $13.3 million in termination costs for the airframes, and $145.6 million for the aircraft that had been manufactured and intended for the low-thrust J40. See Paul D. Foote, Assistant Secretary of Defense (Research and Engineering), "Research Management in the Department of Defense," remarks before Defense Science Board, Offices of the RAND Corporation, Santa Monica, Calif., 11 September 1958, 4-5, copy attached as tab F, item 5, Minutes of the Ninth Meeting of the Defense Science Board, 10–11 September 1958, box 834, Subject Files (Research and Development, 1953–1960), OSD/HO. Foote cited the F3H–1 program as an illustration of the alleged pitfalls of pursuing a concurrent, as opposed to a sequential acquisition strategy when subsystems were unproven.

142. The Surveys and Investigations Staff of the House Appropriations Committee, as part of its inquiry into Department of Defense procurement policies and practices, claimed to have "discovered the costly F3H–1 program during the early part of July 1955" (Procurement Policies and Practices report, 157). Subsequently, the Senate Preparedness Investigating Subcommittee, chaired by Sen. Lyndon Johnson, looked into the FH3–1 program as did the Military Operations Subcommittee of the House Government Operations Committee, chaired by Rep. Chet Holifield (D-Calif.). The latter subcommittee held extensive hearings (24–27 October 1955) and issued a report. See also "The Problems of Westinghouse," *Time* 66, no. 17 (24 October 1955): 98; "Demon on the Ground," *Time* 66, no. 19 (7 November 1955): 101; and articles in *The Washington Post and Times Herald*, October 25, 26, 27, and 28, and November 4, 1955.

143. Tenth Intermediate Report, 41. The subcommittee held McDonnell accountable for allowing installation of J40 engines in the F3H–1 that it knew to be underpowered (34, 38).

144. Ibid., 42-43.

145. See Confidential Notes of Division Directors' Conference of 5 October 1955, encl. to memo, Chief, Bureau of Aeronautics for Distribution List, 5 October 1955, 3, folder Division Directors' Conference Notes, 1955, box 7, entry 201, RG 72. Russell's statement before the Military Operations Subcommittee later in the month was more measured. See Russell statement, 30.

146. See excerpts from Secretary of the Navy Thomas' letter to Sen. Lyndon B. Johnson, Press Release No. 1041-55, Office of Public Information, Department of Defense, 22 October 1955, folder F3H Demon, box 858, Subject Files (Research and Development, 1953–1960), OSD/HO; and Russell statement, 30.

147. Capt. J. N. Murphy, BuAer, "Production and Introduction of New Model Aircraft to the Fleet," presentation before the Air Board, 2 December 1953; and OPNAV Instruction 03700.7 (Introduction of New Model Carrier Aircraft into the Fleets), 14 October 1954: both in folder FIRM History Working Papers, #1 of 4, box 7, entry 5, RG 402.
148. Press Release No. 82-55 (Aircraft Procurement System Modernized by Navy), Office of Public Information, Department of Defense, 27 January 1955, folder Aircraft, 1955, box 854, Subject Files (Research and Development, 1953–1960), OSD/HO. The title Fleet Introduction of Replacement Models or its acronym, FIRM, did not appear in the Department of Defense press release, but Secretary of the Navy Thomas used both in congressional testimony soon after. See Statement of Secretary of the Navy Charles S. Thomas Regarding the Navy Air Procurement Program before the Special Investigating Subcommittee of the House Armed Services Committee, 4 February 1955, 3-6, folder FIRM History Working Papers, #3 of 4, box 7, entry 5, RG 402. For other descriptions of FIRM, see "New Pattern for Aircraft Production," 1 May 1955, encl. to ltr, Chief, Bureau of Aeronautics to Distribution List, 11 May 1955, sub: Meeting Production Schedules, Importance of; and BuAer Instruction NAVAEROO.66 (Fleet Introduction of Replacement Models, [FIRM]; policy concerning), 12 May 1955: both in folder FIRM History Working Papers, #4 of 4, box 7, entry 5, RG 402; "Fleet Introduction Replacement Models," *Naval Aviation News*, May 1955, 1-5; and Semiannual Report of the Secretary of the Navy, January 1 to June 30, 1955, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1955*, 185-87.
149. Rear Adm. Robert E. Dixon, Deputy and Assistant Chief, BuAer, presentation before Ad Hoc Group to Study Department of Defense Methods and Procedures for Research, Development, Procurement and Production [Robertson committee], 9 November 1955, 4, folder FIRM History Working Papers, #1 of 4, box 7, entry 5, RG 402 [hereafter Dixon presentation].
150. George A. Spangenberg, "Aircraft Acquisition—Management Malpractice," in *Wings of Gold*, Fall 1981, 57.
151. Booz, Allen & Hamilton, app. to "Study of Aircraft Procurement Contract Types and Methods," 26, 17 December 1957. Prepared for the Bureau of Aeronautics, Department of the Navy by Booz, Allen & Hamilton, Management Consultants, New York [hereafter App. to BAH Aircraft Procurement study]. The Crusader's swept wing was designed to change the angle of incidence seven degrees. Lowering the wing permitted speeds slow enough to land in a relatively short distance on a carrier's deck while at the same time keeping the aircraft's nose level enough to afford the pilot good visibility. In 1953, when the J57 was selected for the F8U–1, the engine was still under development. But, according to BuAer, "because of the very favorable status of that program, it is expected that the XF8U–1 will not suffer the problems of engine unavailability which have plagued so many other fighter development programs." See Bureau of Aeronautics Material for the Naval History Program of Administrative Problems of the Present National Emergency, 1 January 1953–30 June 1953, n.d., 13, folder BuAer Material for SecNav, box 6, entry 172 (Management Engineer Records Collected by the Navy History Office, 1921–1959), RG 72.
152. Barrett Tillman, *MiG Master: The Story of the F–8 Crusader*, 2d ed., xiii. On 21 August 1956, an F8U–1 set the world speed record for production aircraft of 1,015.428 mph in level flight (Tillman, 52-54).
153. App. to BAH Aircraft Procurement study, 27. At this time, the Navy had two methods of acquiring new aircraft: competitive procurement or negotiated procurement with a single supplier. The latter would be used for three reasons: to acquire existing models requiring significant modifications, to acquire a model initiated by a contractor, or to purchase an "off-the-shelf" model (i.e., one already developed). See Dixon presentation, 3-4.
154. See chap. 9 in this volume; Staff Papers Prepared for the Ad Hoc Study Group, *Program for Reducing the Time Cycle from Concept to Inventory*, Vol. III, *Simpler Procedures Covering Department of Defense–Contractor Relationships*, Pt. I, "More Expeditious Selection of Designs," July 1956, 21, folder A20, vol. 4, box 124, entry 1004I (Secret General Correspondence, 1956),

RG 72; and Norman Waks, "Selective Competition in New Air Weapon Procurement," doctoral thesis, Graduate School of Business Administration, Harvard University, January 1961, IV: 7-9.
155. Waks, "Selective Competition," IV:12, 15.
156. App. to BAH Aircraft Procurement study, 27.
157. Dixon presentation, 12. The letter contract had been amended to reduce the number of experimental prototypes from three to two.
158. App. to BAH Aircraft Procurement study, 28, and chart following 28. Twenty of the aircraft ordered in October were a photo-reconnaissance version, the F8U–1P. In all, Chance Vought built 318 F8U–1s. When production ended in 1965, the Navy and Marine Corps had purchased 1,219 of all versions of the Crusader, including 625 F8U–2s. See Tillman, *MiG Master*, 15-17.
159. In March 1956, Rear Adm. W. A. Schoech, assistant chief for research and development in the Bureau of Aeronautics, informed division directors: "There is, as everyone knows, a national effort being devoted to decreasing the period of time between the inception of an airplane and its introduction into active service in squadrons, . . . We are particularly anxious to speed up the introduction of the P6M into the Fleet, and the F8U. . . . This interest is particularly at a feverish pitch at high levels, particularly at the Secretarial level, and we are reacting to that positively. All Division Directors should be prepared to speed up the P6M and F8U, and make deliveries if it is feasible." See transcript of Division Directors' Meeting of 7 March 1956, 47-48, folder Division Directors' Meeting, March–April 1956, box 3, entry 201, RG 72.
160. Glenn, *John Glenn*, 163.
161. CNO Personal No. 19 to Flag and General Officers, 19 February 1957, 12, sub: Dope, Post 1 Jan 1946 Command File, OAB, NHC.
162. George A. Spangenberg, draft remarks concerning procurement presented to the Society of Experimental Test Pilots, Los Angeles, Calif., 1974; and Spangenberg, a retyped paper on Program Analysis and Evaluation prepared for a NAVAIR training program, n.d. Both are available on the Exhibits section of the George Spangenberg Oral History website, http://www.georgespangenberg.com/exhibitindex.htm as Exhibits A-4 and A-5 (retrieved 26 July 2011).
163. Ltr, F. A. Bantz, Assistant Secretary of the Navy (Material), to Rear Adm. M. E. Arnold, 20 December 1957, sub: Precept Convening a Board to Study and Report upon the Adequacy of Naval Aviation Support, box 27, entry 1037 (Records of the Arnold Board, 1953–1958), RG 72.
164. Report of the Board Convened by the Assistant Secretary of the Navy (Material) to Study and Report upon the Adequacy of Naval Aviation Support, I: 1, 1 March 1958, box 27, entry 1037, RG 72.
165. Ibid., I: 5.
166. Ibid., III-D-109, 111-12.
167. Ibid., III-D-112.
168. General Accounting Office, Comptroller General of the United States, *Review of Aircraft Procurement Programs in the Department of the Navy*, Pt. I, February 1960, 3, folder GAO Aircraft Procurement Programs in Navy, 1960, box 10, entry 46, RG 343 [hereafter GAO review, Part I]. The Bureau of Naval Weapons prepared comments on the draft of Part II of the GAO report. See BuWeps Proposal for Navy Position on GAO Draft Report of 26 January 1961 on *Review of Aircraft Procurement Programs in the Department of the Navy*, Pt. II, encl. to ltr, Chief, Bureau of Naval Weapons to Chief of Naval Material, 17 March 1961, sub: GAO Report on Aircraft Procurement, folder GAO Reports and A/C Procurement, 1961–1963, box 10, entry 46, RG 343 [hereafter BuWeps comments on GAO review, Part II].
169. GAO review, Part I, 6, 10-13, 15-20, 23-30, 65-67; and BuWeps comments on GAO review, Part II, 15, 39. The bases for the GAO studies were case study investigations of the F7U Cutlass, the F8U Crusader, the P6M SeaMaster, and the T2V training aircraft.
170. GAO review, Part I, 11; and BuWeps comments on GAO review, Part II, 7-10.
171. BuWeps comments on GAO review, Part II, 61.
172. Ibid., 11 [italics added]. See also 44, 47-49: "Without question there were a substantial

number of aircraft service changes in the F8U–1. The more advanced an aircraft is in design the more changes will be required. The need for many changes can only be determined by a great deal of flying in BIS [Navy Board of Inspection and Survey testing, the second phase of testing following contractor tests] and in the fleet. New improvements and new operational requirements during the course of any program also cause many changes" (47-48).

173. Chief of Naval Operations to Distribution List, 9 December 1955, OPNAV Instruction 3300.6 (Standardization of Weapon System Definitions), folder OPNAV Inst 3300.6, box 10, entry 5, RG 402.

174. Libby Board report, I: 1-2, III: 7-16.

175. For the Sidewinder, see Ron Westrum, *Sidewinder: Creative Missile Development at China Lake*.

176. Booz, Allen & Hamilton, *Review of Navy R&D Management*, Vol. II, 53.

177. See, for example, memo, Col. E. C. Best, Director, Electronics Division for Assistant Chief for Research and Development, BuAer, 26 March 53, sub: Systems and Equipment, Cognizance of; and memo, Capt. Grayson Merrill, Director, Guided Missiles Division, for Assistant Chief for Research and Development, BuAer, 28 April 1953, sub: Reorganization of the Research and Development Group: both in folder BuAer R&D, Organization, Misc. Memos, 1951–1959, box 3, entry 8, RG 402; and memo, Cdr. N. R. Richardson, Aer–23, for Aer–2, Aer–20, 3 July 1953, sub: R&D Organization and Procedures, Conclusions and Recommendations Concerning, folder Fawkes Committee, box 14, entry 176, RG 72.

178. Ad Hoc Study Group, *Manned Aircraft Weapon Systems: A Program for Reducing the Time Cycle from Concept to Inventory,* July 1956, 30, box 10, BAH Records, OAB, NHC [hereafter Ad Hoc Study Group preliminary report]; and Booz, Allen & Hamilton, *Review of Navy R&D Management*, Vol. I, 42-43.

179. Ad Hoc Study Group preliminary report; and Booz, Allen & Hamilton, *Review of Navy R&D Management*, Vol. I, 340.

180. Aircraft Division Complete List of Contracts, Model Designations, and Project Officers, 30 March 1959, encl. to Briefing Data on the Aircraft Division, 23 April 1959, folder BuAer R&D Organization Misc. Memos, 1951–1959, box 3, entry 8, RG 402; and Glenn, *John Glenn*, 165-66.

181. See testimony of Capt. N. R. Richardson, Chief, Aircraft Division, BuAer, before the Ad Hoc Committee to Study Organization of R&D Group in BuAer [the Fawkes Board, after its chairman, Capt. E. E. Fawkes], 11 January 1956, 22-23, box 19, entry 176, RG 72.

182. Booz, Allen & Hamilton, *Review of Navy R&D Management*, Vol. I, 43.

183. *Maximum Improvement in Air Weapon Systems in Minimum Time: Summary of Actions Taken to Reduce the Time Required for Research, Development, Procurement, and Production of Manned Aircraft Weapon Systems*, 8 February 1957, 12, encl. to ltr, Reuben B. Robertson, Jr., Deputy Secretary of Defense, to Secretary of Defense, 9 February 1957, folder Research and Development (General), 1956–1959, box 832, Subject Files (Research and Development, 1953–1960), OSD/HO; Annual Report from the Chief of the Bureau of Aeronautics to the Secretary of the Navy, Fiscal Year 1957, 64-65, encl. to ltr, Chief, Bureau of Aeronautics to Secretary of the Navy, 19 August 1957, folder Management Improvement Report 1957, box 6, entry 176, RG 72; Booz, Allen & Hamilton, *Study of Aircraft Procurement Contract Types and Methods*, 202, 17 December 1957. Prepared for the Bureau of Aeronautics, Department of the Navy by Booz, Allen & Hamilton, Management Consultants, New York [hereafter BAH Aircraft Procurement study]; and Booz, Allen & Hamilton, *Review of Navy R&D Management*, Vol. I, 43.

184. Memo, Captain S. R. Ours, Director, Aircraft Division, for Chief, Bureau of Aeronautics via Assistant Chief for Research and Development, 8 July 1958, sub: Management of Aircraft Programs in the Bureau of Aeronautics, Recommendations Concerning, folder BuAer R&D, Organization, Misc. Memos, 1951–1959, box 3, entry 8, RG 402.

185. See memo "R" [the organizational symbol for the assistant chief for research development, test, and evaluation in BuWeps, then Rear Adm. E. A. Ruckner] for "C" [the symbol for the

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190. Ibid., 429, 441.

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193. Discussion of BuWeps Program Management System, February 1962, 3, encl. to memo, Gulick for Admiral Townsend, 26 February 1962.

194. "'Intruder' Has Many Features," *Naval Aviation News*, June 1960, 28.

195. Francillon, *Grumman Aircraft*, 429.

196. App. to BAH Aircraft Procurement study, 9-10, 16. Allowing the aircraft manufacturer to procure the engine was unusual for aircraft acquisition programs of the day. Even the Air Force in implementing weapon system procurement in the B–58 program furnished the engine to Convair. In the case of the Allison J71 being developed by the Air Force, the Bureau of Aeronautics believed, according to Booz, Allen & Hamilton, that "Martin could coordinate the early development and obtain delivery more expeditiously than the Navy." In contracts for quantity production of the aircraft, the Navy planned to furnish the engines (16).

197. Statement of Vice Adm. E. W. Clexton, Chief of Naval Material, Senate Select Committee on Small Business, *Government Procurement—1957: Hearings before a Subcommittee of the Select Committee on Small Business*, 85th Cong., 1st sess., March 11, 12, and 13, 1957, 178.

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199. Trimble, *Attack from the Sea*, 134-36.

200. Francillon, *McDonnell Douglas Aircraft*, Vol. II, 175, 181; and Glenn E. Bugos, *Engineering the F–4 Phantom II: Parts into Systems*, 2-3.

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III. Sources: Hal Andrews, "Naval Aeronautics Loses Noted Engineer—George Spangenberg," *Naval Aviation News* 83, no. 3 (March–April 2001): 29-30; "George Spangenberg: Aeronautical Engineer," *Washington Post*, 26 November 2000, C7; and "George A. Spangenberg: Naval Air Advocate and Design Leader," George Spangenberg Oral History website, http://www.georgespangenberg.com/dadsbio.htm (retrieved 26 July 2011).

CHAPTER XI

Creating a Missile and Rocket Force: The Army and Acquisition, 1953–1960

On Friday evening, 31 January 1958, two groups of Army officials, one at Cape Canaveral in Florida and the other in the Pentagon, tensely awaited the service's attempt to place the first U.S. satellite in orbit. In a blockhouse at the Cape, directly observing the launch of the modified Jupiter-C missile carrying the satellite, was Maj. Gen. John B. Medaris, commander of the Army Ballistic Missile Agency. The Pentagon group, which would learn of unfolding events via teletype, included Secretary of the Army Wilber M. Brucker and the famous Dr. Wernher von Braun, who along with approximately 120 other German rocket engineers had been brought to the United States by the Army under Operation Paperclip in 1945–1946. Von Braun's team at the Army's Redstone Arsenal in Huntsville, Alabama, in cooperation with the Jet Propulsion Laboratory at Caltech in Pasadena, had developed the space system from existing technology. The four-stage Jupiter-C, designated Juno I, was 83 feet tall. A liquid-fuel Redstone booster, an evolution of the German V–2 ballistic missile, constituted the first stage. The second, third, and fourth stages, all powered by scaled-down versions of the Army's short-range, solid-fuel Sergeant surface-to-surface ballistic missile, were contained in a cylindrical housing that began to rotate atop the Redstone about ten minutes prior to launch. The fourth stage was the satellite, Explorer I. It protruded needlelike from the revolving second and third stage housing and consisted of a single Sergeant missile and an instrument payload with some of its components developed in Army Signal Corps laboratories. Together, the fourth stage's missile and payload comprised a cylinder 6.5 inches in diameter and almost 7 feet in length. At 10:48 p.m. the Redstone's engine ignited and a few seconds later Juno I lifted off. A long hour and a half passed before tracking stations in California acquired the satellite approaching from the west, confirming that Explorer I had achieved orbit.[1]

The Army's Juno I, carrying Explorer I, the first U.S. earth-orbiting satellite, just prior to launch, Cape Canaveral, Florida, 31 January 1958.
Courtesy, U.S. Army Aviation and Missile Life Cycle Management Command.

The Army's stunning success, coming within four months of the shock of the first Soviet Sputnik and in the wake of the setbacks experienced by the Navy's competing Vanguard program, demonstrated the service's leadership in missile technology and seemed to affirm the value of its arsenal system.[2] Yet in the Army, much as in the Navy with Polaris, an outstanding technological achievement tended to mask serious deficiencies in weapons acquisition organization and processes.

This chapter begins with a sketch of the Army in the 1950s, highlighting its transition to a nuclear missile and rocket force. It then focuses on acquisition—first, on the decade's most contentious organizational issue, the centralization of research and development management; next, on the service's efforts to reduce the period between the inception of the concept for a weapon system and its delivery to troops (its lead time); and, finally, on the three different approaches employed by the Army's ballistic missile command in managing the acquisition of new systems.

THE NUCLEAR ARMY OF THE EISENHOWER ERA

The Army of the 1950s belies that service's traditional image as the least technologically oriented of the armed forces. In the years following the Korean War, it kept pace with and at times led the Air Force and Navy in developing and fielding nuclear-armed guided missiles and rockets, the era's most advanced weapons. These systems shaped the Army more than any other single factor. In 1956, General Maxwell Taylor, the Army's chief of staff, asserted that the service's "most pressing problem" was "to assess the impact of atomic-bearing missiles and projectiles on the nature of the land battle, and then, to effect a proper adjustment of organization, techniques, equipment, and weapons."[3] Ironically, at the same time it embraced nuclear systems, the Army rejected the national security strategy that relied on them.

The Army and the New Look

For the incoming Eisenhower administration, economic insolvency could threaten national security as much as lack of military strength. To avoid the high cost of large conventional forces, it chose to rely on the threat of massive retaliation with nuclear weapons to deter war. Army objections to this national security strategy, called the New Look, were to no avail. The service suffered severe cutbacks throughout the decade.

In FY 1954, reflecting its prominent role in the Korean War, the Army drew almost 40 percent of the Defense Department budget. Thereafter, indicative of both the end of the war and the New Look strategy, the Army's appropriation shrank rapidly. From FY 1955 through FY 1961, it annually received the smallest share of the budget, averaging about 23 percent to the Navy's nearly 30 percent and the Air Force's just over 44 percent.[4] Force levels and personnel strengths experienced corresponding declines. At the peak of the Korean War, the 20-division Army numbered more than 1.5 million personnel. By mid-1960, the active force included only 14 divisions and 873,000 personnel.[5]

ARMY ACTIVE FORCES
FY 1954–FY 1961

FY	1954	1955	1956	1957	1958	1959	1960	1961
Divisions [1]	18	19	20	19 (3R)	17	16	15	15
Regiments	18	12	10	9	5	5	5	6
Personnel [2]	1,405	1,109	1,026	998	899	862	873	859

1. R = Reduced strength.
2. Personnel figures (in thousands).


General Maxwell D. Taylor, chief of staff, U.S. Army, 1955–1959.
Courtesy, U.S. Army Center of Military History.

Despite its much smaller size, the Army appeared to have a vital mission during the 1950s. Together with the armies of its fourteen NATO partners, it was charged with the forward ground defense of Western Europe. The reality, however, was somewhat different. In late 1954, NATO agreed that Europe's defense would depend both on nuclear weapons and standing conventional forces. But in May 1957, the alliance approved a strategic concept that shifted the balance almost entirely in the nuclear direction. NATO would not defend Europe by fighting a large-scale conventional war; rather, even if the Soviet Union did not use nuclear weapons, the Western allies, far outnumbered by Warsaw Pact forces, would be prepared to do so.[6] Thus, the five U.S. Army divisions stationed in Germany became both a trip wire and a symbol—a wire that when tripped would likely prompt the quick introduction of nuclear weapons leading to a strategic nuclear exchange, and therefore also a symbol of the U.S. commitment to bring Western Europe under the umbrella of massive retaliation.[7]

If the Army was not expected to fight a large-scale ground war in Europe, then little seemed left for it to do. It shared responsibility with the Air Force for the air defense of the homeland by defending point targets, particularly cities and vital military installations, with its antiaircraft gun and missile systems.[8] But the air defense task was not a glamorous mission. Even less so, given the service's proud tradition, was another role that President Eisenhower envisaged for the Army in a future war. In a May 1956 meeting at the White House, the commander-in-chief told General Taylor that, should war occur, the Army's principal job would be to maintain order at home.[9]

Throughout the 1950s, Army officers, especially General Matthew Ridgway, chief of staff from August 1953 through June 1955, and General Taylor, his successor through June 1959, repeatedly challenged the strategy of massive retaliation, usually within government councils but sometimes publicly (particularly in the service's professional journals). They refuted the administration's assumption that future conflict would quickly become all-out nuclear war, arguing instead that both sides' possession of the means to destroy the other meant that strategic nuclear weapons would not be used. In their view, warfare would more likely be limited and range across the conflict spectrum from small-unit guerrilla actions through large-scale conventional operations in which tactical nuclear weapons might be employed. Consequently, the United States must develop "balanced" military capabilities including strong conventional forces. Beginning in 1956, General Taylor began to articulate the Army's position as an alternative to the New Look. Eventually known as "flexible response," it entailed creation of a force structure ready to respond to conflict at any level.[10] The Army's arguments, however, did not persuade Eisenhower. The service would have to await John F. Kennedy's presidency for its views on the nature of future warfare to become the basis of a new national security strategy.

Nuclear Missiles and Rockets: A Logical Extension of Artillery

Debates over strategy notwithstanding, the Army sought to adapt itself to the realities of the nuclear age and Defense Department budget priorities. The advent of smaller and lighter nuclear warheads in the early 1950s, coupled with rapid advances in missile technology, enabled the Army to develop a wide range of nuclear systems for battlefield use. As the 1952 Vista conference report and other studies had made clear, tactical nuclear weapons could help offset the manpower advantages possessed by Soviet and Chinese armies.[11] The 280-mm. "atomic cannon" was the Army's first system of this kind, successfully firing an atomic shell in May 1953. By the end of the Eisenhower administration in 1961, the Army had fielded numerous nuclear weapons–capable surface-to-surface missile and rocket, as well as air defense missile systems. Throughout the 1950s, however, aspects of the Army's successful and expanding missile program met determined opposition from the Air Force, which feared encroachment on its primacy in strategic offensive operations and in continental air defense.

By 1960, nuclear-tipped surface-to-surface missiles and rockets gave Army ground commanders firepower of unprecedented range and destructiveness.[12] In 1954, the Army deployed Corporal, the first operational U.S. ballistic missile, and Honest John, an unguided rocket. The mobile, liquid-fuel, 45-foot long Corporal, which was controlled at corps level, could strike targets at ranges up to 75 nm with a 275 meter CEP (circular error probable). The solid-fuel, 27-foot long Honest John, also mobile with a track-mounted launcher, had a range of 14 nm and was organic to armored and infantry divisions. In 1958, the liquid-fuel Redstone ballistic missile, assigned to field army headquarters and able to reach targets out to 175 nm, became operational. Many of its subsystems were used in the 1,500 nm Jupiter intermediate range ballistic missile system, developed by the Army but turned over to the Air Force for employment. Finally, in mid-1959, the Army fielded Lacrosse, a surface-to-surface, solid-fuel, close-support guided missile that could carry a nuclear warhead and was accurate from 5 to 40 meters against targets from 4 to 16 nm distant.[13] By the time Eisenhower left office, second-generation Army surface-to-surface missile and rocket systems were in advanced stages of development. Three relatively short-range nuclear weapon systems were in the hands of field units in 1961—an improved Honest John, with range extended to nearly 22 nm; the Little John rocket, with a 10 nm range and, at 12 feet in length, transportable by helicopter; and the 1 to 2 nm range Davy Crockett that was designed for a direct fire role at platoon level. Two ballistic missile systems, the solid-fuel, 75 nm Sergeant, successor to Corporal, and the solid-fuel, two-stage, 200 to 400 nm Pershing, follow-on to the Redstone, deployed overseas in 1963 and 1964, respectively.[14]

Honest John rocket on launcher.
Courtesy, U.S. Army Aviation and Missile Life Cycle Management Command.

Left to right: Representative George H. Mahon (D-Tex.), chairman of the House Subcommittee on Defense Appropriations; Army Chief of Staff General Maxwell D. Taylor; and Secretary of the Army Wilber M. Brucker, with model of the Army's Juno I that carried the Explorer I satellite into orbit.
Courtesy, U.S. Army Center of Military History.

In addition to its surface-to-surface systems, the Army also fielded several surface-to-air missiles in air defense roles during the 1950s. By 1960, they had completely replaced the Army's 75-mm. Skysweeper, 90-mm., and 120-mm. antiaircraft guns.[15] The 25 nm range Nike Ajax, the first operational U.S. guided missile, was equipped with a conventional warhead and entered service in December 1953. Its nuclear-tipped successor, the 80 nm range Nike Hercules, became operational in June 1958. The two missiles were designed to engage aircraft at high altitudes—Nike Ajax up to 70,000 feet and Nike Hercules to 150,000 feet.[16] By 1958, 200 Nike Ajax batteries, each with 12 missile launchers, defended American cities and key military sites. A few of the 145 Nike Hercules batteries, also with 12 launchers each, that were fielded by the Army beginning in 1958, stood guard until the late 1970s.[17] Hawk, a nonnuclear surface-to-air missile with a 20 nm range, primarily targeted low-flying aircraft threatening field forces and was deployed in 1960.[18]

Elements of the Army's missile program generated hostile and long-lived rivalries with the Air Force. Jurisdictional disputes between the two began during World War II, when both the Army Service Forces and Army Air Forces initiated guided missile research and development programs. After the Korean War, Army–Air Force conflicts over guided missiles were fiercely partisan and often waged in public—the 1950s equivalent of the Air Force–Navy clash over strategic bombardment in the late 1940s (see chap. 7).[19]

To the Army, missiles were simply the latest advances in field artillery. During the Korean War, Secretary of the Army Frank Pace requested a study of their role in Army operations. One of the ensuing report's major points was that "free rockets and guided missiles provide a logical and essential extension of [the artillery] arm, greatly increasing its range and effectiveness."[20] Another of its contentions was that range restrictions should not be imposed:

> An arbitrary limitation on range for Army missiles, based solely on an expected depth behind the enemy lines in which the bulk of the Army targets would be located, would be unrealistic and illogical. On the one hand, it will be desirable for the Army in many instances to locate its guided missile firing points well to the rear for both logistic and security reasons. On the other hand, it is not possible intelligently to establish in advance the depth behind enemy lines within which the targets required to be covered by the Army would be located, for that depth will vary with a number of factors which cannot be accurately determined in advance and may be influenced by the development of new weapons and other technological advances.[21]

Throughout the 1950s, the Army consistently maintained that its guided missiles were a "logical extension" of artillery and that their range ought not to be limited.[22]

The Army's insistence that it be able to develop missiles with unlimited range worried the Air Force. Airmen feared that Army-produced long-range missiles might be used to attack strategic targets, thus undermining the new service's primacy in that role; or to strike at long distances against aerial intruders threatening the homeland, thus weakening the Air Force's responsibility for area defense of the continent; or to place payloads in space, the military environment of the future that the Air Force hoped to dominate. Following the Korean War, the two noisiest and most bitter disputes generated by such concerns involved the Army's Jupiter and the Air Force's Thor IRBMs, each with a range of 1,500 nm; and two surface-to-surface antiaircraft missiles, the Army's Nike Hercules with a range of 80 nm, and the Air Force's Bomarc B with a range of 400 nm.[23]

In addition to the Air Force, at times the Navy, as well as the Office of the Secretary of Defense (the latter concerned more about the cost of apparently duplicative programs rather than service roles and missions), rejected the Army's position. In the 1950s, these forces sometimes allied to limit the range of Army missiles. In late 1954, for example, prodded by pressure from Donald Quarles, then the assistant secretary of defense for research and development, the Joint Chiefs of Staff decided that the Army could only develop antiaircraft missiles with ranges up to 50 nm for the point defense of cities and military facilities (the

Air Force had pressed for 25 nm, the actual range of the then-deployed Nike Ajax). With respect to surface-to-surface missiles, however, the JCS placed no specific limitation on the Army, allowing it systems that could strike tactical targets within an undefined "zone of Army combat operations." At this time, the Army was considering surface-to-surface missiles with ranges up to 500 nm.[24]

In 1955, the report of the White House's Killian panel, which emphasized the urgent need for either a land-based or sea-based IRBM, followed by the Eisenhower administration's decision to support two programs—the Air Force's Thor and the joint Army-Navy Jupiter—appeared to validate the Army's contention that it should be able to develop long-range missiles. A year later, with the contest between Thor and Jupiter well under way and the issue of whether the Army would be allowed to operate its missile not yet resolved, Secretary of Defense Wilson moved to restrain interservice competition by putting range limits on Army surface-to-surface and surface-to-air missiles. On 26 November 1956, he directed that the envelope for Army surface-to-surface missiles not exceed 200 nm (100 nm on either side of the front lines), and that the service should not plan on operational employment of Jupiter, although it might continue to study the feasibility of missile systems with ranges beyond 200 nm. Wilson also somewhat expanded the 50 nm range limitation on Army antiaircraft missiles, increasing it to 100 nm.[25]

In the end, Wilson's attempt to define service roles and reduce interservice wrangling by imposing range limitations on surface-to-surface and surface-to-air missiles had little effect. In August 1957, over Wilson's and JCS Chairman Admiral Arthur Radford's objections, President Eisenhower decided that no service missile should be restricted by range. Subsequently, in January 1958, after the alarm raised by the Soviet Sputniks, the JCS supported and Neil McElroy, who replaced Wilson as defense secretary, approved the Army's plans for a 200–300 nm range, solid-propellant missile, to be named Pershing. Moreover, despite a rancorous public feud between the Air Force and the Army and calls from Congress to choose one or the other, both the 400 nm range Bomarc B and the shorter-range Nike Hercules continued in development, and were eventually deployed in substantial numbers.[26]

Tactical Doctrine, Organization, and Materiel

The Army believed that the destructive power of nuclear warheads along with the speed and range of their delivery vehicles had radically transformed the battlefield. That transformation resulted in changes in tactical doctrine, organization, and supporting materiel. Development, production, and deployment of some of that equipment, however, did not keep pace with new doctrine and organization. Moreover, despite the Army's contention that future conflict was likely to be limited, its conventional weaponry generally lagged even further behind.

To the Army, the employment of nuclear weapons meant that battlefields would be much larger (deeper and wider) and more lethal than those of World War II. The slow massing of large troop formations would not be possible, and movement would be severely restricted. In 1957, in remarks to the commandants of the Army's professional schools, General Taylor noted that more attention had to be paid to night operations because "certainly, at the outset of a nuclear war, there will be no daylight movement, except by very small bodies of troops, and concealment will be the order of the day. The usual posture of a unit in daylight will be concealment under cover, dug in, ready to accept, if discovered, an attack by atomic weapons."[27] To survive and operate effectively in a nuclear environment, tacticians believed that ground forces must initially be dispersed and have some form of protection. But they must also be able to concentrate rapidly to strike the opponent and then disperse again quickly to avoid nuclear counterattack.[28]

The Army viewed its traditional triangular division (three regiments with three battalions each) as ill-suited for operations of this kind. Consequently, in 1956, under Taylor's leadership, it introduced a new tactical formation, the so-called pentomic division comprising five battle groups, each smaller than a regiment but larger than a battalion, relatively self-contained, and able to operate semi-independently. But, by the end of the decade, Army leaders had become dissatisfied with the pentomic structure. General George H. Decker recalled that one of his first actions when he became chief of staff in October 1960 was to begin to reorganize the Army's divisions.[29] Decker believed that the pentomic division was "more or less a jack-of-all-trades and master-of-none. It was too light to provide for any sustained combat." He also thought "the echelons of command were inadequate because [the command line went directly] from the division commander down to the battle group commander. There was no intermediate commander in there, such as a regiment or a brigade."[30]

To meet the anticipated demands of the nuclear battlefield, the Army sought to develop materiel that would give its forces protection, mobility, and flexibility. The M113 armored personnel carrier, for example, began development in 1956 and was fielded in 1960. A significant improvement over its predecessors, the M113 could carry 11 soldiers plus 2 crewmembers at a top speed of 40 mph on roads, enabling the infantry to keep pace with advancing armor. It was also air-transportable, air-droppable, and possessed amphibious capability.[31]

Expansion of the numbers of fixed and rotary wing aircraft, used primarily to move troops and supplies, also increased the Army's mobility. By 1960, almost half of the service's 5,500 aircraft were helicopters.[32] In a landmark 1954 article ("Cavalry, And I Don't Mean Horses"), Maj. Gen. James Gavin had pointed to the need for helicopters and light aircraft that could carry out tactical missions. Considerable doctrinal development followed, but the Army would not implement the air assault concept until the early 1960s.[33]

Advances in electronics, particularly transistors, improved the command and control and dependability of communications essential for semiautonomous pentomic units moving rapidly across spacious nuclear battlefields.[34] In 1957, General Taylor told the school commandants that improved signal communications would allow increased span of control: "In Korea, I was able to experiment with divisions which contained from five battalions to twelve battalions and check the possible [expansion of the] span of control, utilizing the equipment then available. I became convinced that it is possible to go well beyond the conventional three subordinate units which we have in our triangular organizations."[35] When the Korean War started, Signal Corps research and development funding was $30 million; by FY 1959, it had increased to over $185 million. In that year, the Signal Corps delivered the first of 17 improved or entirely new tactical communications systems and began to procure 18 others, most of the latter combat surveillance equipment including the AN/USD–1 drone.[36]

Despite the need for materiel designed to enhance the mobility and flexibility of pentomic units, some key systems, such as the M113 were not fielded until the end of the decade or later, with a resulting lag between doctrine and its technological application. General Taylor candidly admitted that when the Army reorganized into pentomic divisions, it realized that supporting equipment would not be available for several years. "It seemed to me," he said, "that we could tread water almost indefinitely for that reason, whereas it would be a definite advantage to create at once the organizations which would be ready to absorb the new weapons, now blueprints, as they became available. In the interim we would use the best we had."[37] Modernization of the Army's other conventional weapons moved even more slowly. For example, the M60 tank, although described by some commentators as "a very considerable advance" over the M48 Patton when U.S. units in Europe began to receive them at the end of 1960, was, in fact, an upgrade of the latter and conceived from the start as an interim system.[38]

Some of the gap between pentomic tactical doctrine and the means to exploit it, along with the relative neglect of conventional weaponry, may be attributed to a disproportionate emphasis on increasing nuclear firepower. In FY 1957, missiles (not counting expenditures on their nuclear warheads) absorbed 25.1 percent of the Army's research and development budget, while only 4.5 percent went to vehicles and 4 percent to aircraft.[39] In FY 1961, the Army's total appropriation for RDT&E was nearly $1.163 billion. Missiles accounted for almost 47 percent ($546 million), vehicles totaled 7.7 percent ($90 million), and aircraft consumed just over 2.5 percent ($31 million).[40] In a reflection of the dissatisfaction of some with increasing and disproportionate expenditures for missiles, a May 1959 *Time* magazine article quoted one U.S. Army division commander in West Germany as saying: "For $5 billion worth of troop equipment, I'd trade Huntsville [location of the Army Ballistic Missile Agency] away in a minute." [41] Not until the Kennedy administration's flexible response strategy increased the importance of conventional forces and the Army's role in the nation's defense posture would the service be able to reequip itself across the board.

CENTRALIZATION OF RESEARCH AND DEVELOPMENT MANAGEMENT

By 1953, proponents of assigning greater importance and organizational independence to research and development at Army headquarters and of creating an integrated R&D program had failed to make much headway. But before the end of the Eisenhower administration, they would achieve many of their objectives. In reaching these goals, the aggressive efforts of the Army Scientific Advisory Panel proved to be an important factor. Despite the gains, acquisition management responsibilities in the Army, including those for research and development, continued to be divided among numerous agencies. This fragmented structure made it difficult to fashion a research and development program with coherent purpose or to develop weapon systems efficiently that cut across organizational boundaries. As some observers recognized, the diminished, yet still powerful, product-oriented technical services were at the root of the problem. But, according to the Second Hoover Commission in 1955, this traditional pattern was "so deeply imbedded in the broad organizational structure of the Army . . . that its abandonment would be an almost impossible task."[42] Thus, throughout the 1950s, Army leaders, just as their Navy counterparts with respect to the bureau structure, sought to correct deficiencies without dissolving or even significantly altering the established organizational framework.

The Reorganization of 1954

The compromise reorganization of the Army staff that went into effect at the beginning of 1952 disappointed those within the Army and their supporters in the scientific community who advocated greater independence for research and development, or even its complete separation from procurement and production. It had not created a deputy chief of staff for development as they wanted, but simply changed the title of the existing deputy chief of staff for plans to deputy chief of staff for plans and research while adding some research and development functions to that office. Nor, as the proponents of increased organizational status for research and development had urged, did the reorganization relocate research and development from the Office of the Assistant Chief of Staff for Logistics (G–4) to a separate staff division headed by its own assistant chief of staff. Instead, it established the position of chief of research and development in the Office of the Chief of Staff, but with only a small staff, reporting to the deputy chief of staff for plans and research for day-to-day matters.

Although charged with responsibility for the Army's research and development program, including control of its budget and the allocation of funds, the chief of research and development had only limited authority. All four assistant chief of staff offices—personnel (G–1), intelligence (G–2), operations (G–3), and logistics (G–4)—contained organizational elements that participated in R&D program development and oversight. G–4's research and development responsibilities continued to be particularly significant. Without a staff large enough to execute the office's assigned duties, the chief of research and development had to rely on the Research and Development Division in G–4 to perform the necessary work.[43] But, most importantly, G–4 continued to oversee the technical services where most Army research and development actually took place.

In addition to initiating the headquarters staff reorganization, Secretary of the Army Pace revived the service's moribund civilian Research Advisory Panel, appointing 10 scientists and industrialists to advise him. Renamed the Army Scientific Advisory Panel, it operated informally at first. In 1954, the panel received a formal charter. Unlike its predecessor, the new group met and acted together, instead of its members being consulted individually, and considered broad issues related to the management of research and development rather than the narrow technical matters taken up by the old panel.[44] Chaired initially by James Killian, president of MIT (and, beginning in 1957, President Eisenhower's special assistant for science and technology), the Scientific Advisory Panel allied itself with the research and development forces on the Army staff.

In 1953 and 1954, as part of the reorganization of the Defense Department initiated by the Eisenhower administration, the Army, like the other services, reviewed its own organization. In August 1953, Robert T. Stevens, the new secretary of the Army, appointed a committee headed by Paul Davies, vice president of the Food Machinery and Chemical Corporation (a long-time Army contractor), for this purpose. After interviewing more than 125 witnesses, the Davies committee reported in December. One of Stevens' principal concerns was to ensure that the Army staff focused on policy and planning rather than on operational matters, particularly the activities of the technical services. To address this problem, the Davies committee recommended that a "Supply Command" oversee the technical services; the command, in turn, would report to a newly created second vice chief of staff (for supply). Acknowledging that the position of chief of research and development needed to be strengthened and its authority clarified, the committee proposed several measures to achieve these objectives. The most important was to transfer G–4's research and development planning functions to the chief of research and development, with its other research and development responsibilities going to the proposed supply command. Regarding the Army secretariat's management of materiel, the committee suggested that an assistant secretary take up those duties, then being performed by the under secretary of the Army.[45]

The Davies committee's plan foundered, principally because many viewed a supply command as a return to the Army Service Forces structure of World War II and too drastic an organizational change.[46] In mid-June 1954, Stevens announced a new setup, already approved in principle by Secretary of Defense Wilson. The proposals for a second vice chief of staff and a supply command had been abandoned. In their place Stevens wanted to establish the position of deputy chief of staff for logistics alongside the existing deputy chief of staff for administration and the deputy chief of staff for plans and research. Not only would the new post supervise the technical services, but it would also retain all of the research and development functions formerly carried out by the assistant chief of staff for logistics, G–4. Concerning the Office of the Chief of Research and Development, Stevens intended (without saying exactly how) to "clarify, enhance, and strengthen" the position. In his own office, much as in the original Davies committee's proposal, Stevens planned that a single assistant secretary, for both logistics and for research and development, would manage the Army's materiel activities.[47]

Although uniformed officers and civilians on the Army staff and their scientist supporters who sought organizational independence for research and development were not particularly happy with the Davies committee's recommendations, some of the proposals represented steps in the direction they preferred. However, should all of Stevens' scheme be implemented, their objective of raising research and development's importance in the Army would be set back severely. Following publication of Stevens' reorganization plan, Army officials who advocated strengthening research and development and the scientists who backed them campaigned against R&D's subordination to logistics, with the two groups sometimes working in concert. On 20 July 1954, Lt. Gen. Lyman L. Lemnitzer, the deputy chief of staff for plans and research, complained to the high-level committee formed to implement the Stevens plan that if research and development functions were transferred to the new deputy chief of staff for logistics, "[t]he research and development effort would be fractured to such degree that it would be impossible to provide the necessary support, stimulation and coordination of the program." He suggested that the Scientific Advisory Panel (certain to confirm his views) should be consulted.[48] Three days later, Killian, the panel's chairman, wrote directly to Stevens, asserting that the proposed organization "would serve seriously to handicap the management and further development of the Army in Research and Development activities. . . . It brings Research and Development under the domination of logistics and procurement philosophy, and this had repeatedly been demonstrated to be the wrong environment for the top direction of Research in military services."[49]

Opponents of the Stevens reorganization plan received a boost during the summer of 1954 with the release of the preliminary conclusions of a subcommittee of the House Committee on Government Operations, chaired by New York Republican R. Walter Riehlman, that had been holding hearings on the services' research and development programs since June. Among its findings were that the Army had too closely associated research and development with logistics and had not made adequate use of its scientific advisory committee.[50]

The Army Scientific Advisory Panel considered the R&D organization issue at its first formal meeting in mid-November 1954. An assistant secretary of the Army who attended the sessions concluded that the group believed that changes to the Stevens reorganization plan needed to be made promptly, as parts of it had been implemented already. For example, in late September, Lt. Gen. Williston Palmer, the assistant chief of staff for logistics, had moved into the new deputy chief of staff for logistics post (DCSLOG), assuming the research and development responsibilities identified in the secretary of the Army's plan. A few days after the Scientific Advisory Panel adjourned, Killian formed an ad hoc committee of panel members to present recommendations about the Army's organization for research and development to Stevens.[51]

As a result of the intense lobbying, particularly pressure from the Scientific Advisory Panel, Secretary Stevens modified his reorganization plan. Instead of being transferred to the deputy chief of staff for logistics, the research and development functions formerly carried out by the assistant chief of staff for logistics as well as those of the other assistant chiefs of staff would now be assigned to the deputy chief of staff for plans and research, Lieutenant General Lemnitzer.[52] Opponents of the Stevens plan had succeeded in preventing the deputy chief of staff for logistics from becoming what amounted to head of research and development on the Army staff, but their victory was incomplete. Since the technical services would report directly to the deputy chief of staff for logistics, that official would still have substantial influence over Army research and development.

Organizational Independence and Equality for Research and Development

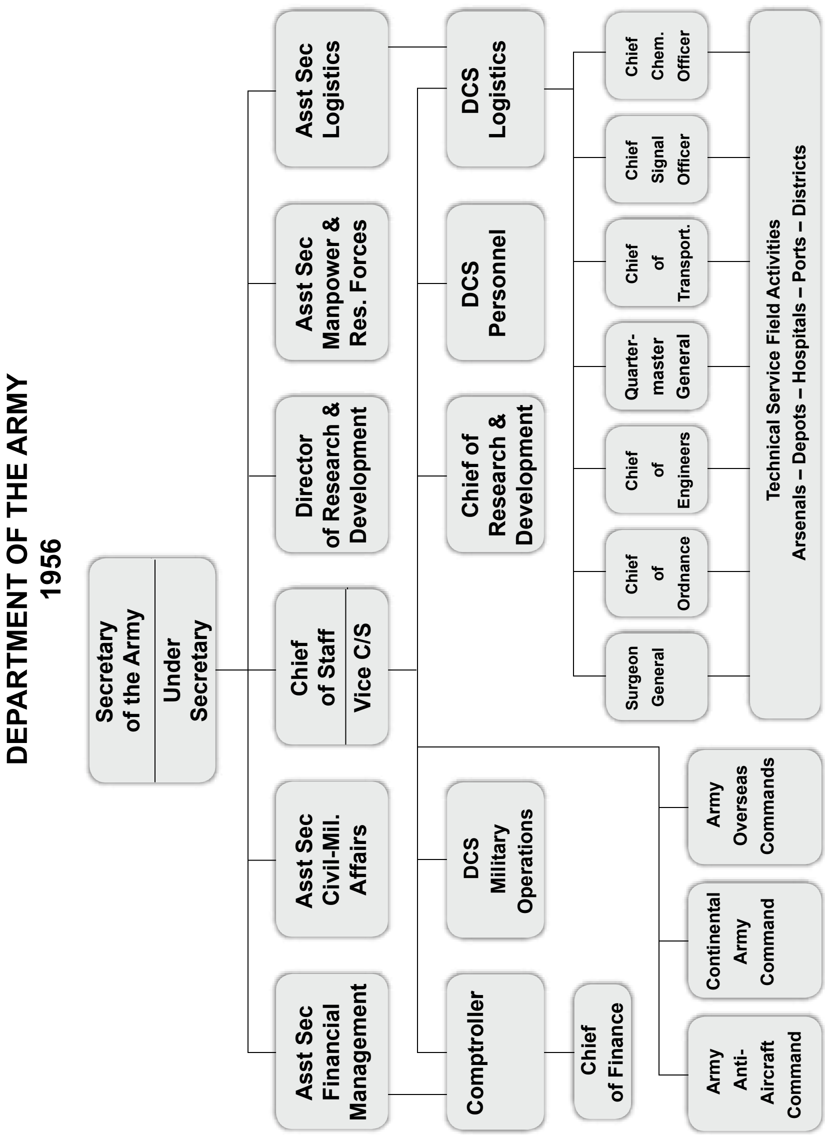
Within a year of the Stevens reorganization, the Army's research and development proponents achieved some of their longtime objectives—organizational independence and equality for research and development in the Army secretariat and on the Army staff. Following criticisms by the McKinsey management consulting firm and by the Second Hoover Commission early in 1955 that the scope of the duties assigned to the assistant secretary of the Army for logistics and research and development was too burdensome, the Army divided management of the two functions.[53] In October, Wilber Brucker, Stevens' successor as Army secretary, created the position of director of research and development in his office and made it organizationally equivalent to the four existing assistant secretary posts (the statutory limit).[54] William H. Martin, then deputy assistant secretary of defense for applications engineering in OSD, became the first director.

On the Army staff, a similar change took place for much the same reason. Lieutenant General Gavin, the deputy chief of staff for plans and research, believed that the work required to support the chief of staff in the latter's role as a member of the Joint Chiefs of Staff prevented him from devoting adequate attention to research and development. Thus, Gavin recommended that the position of chief of research and development be separated from his office and be made organizationally equivalent to the three existing deputy chiefs of staff, although not designated as a deputy chief of staff due to statutory limits on the number of those posts. The remainder of the Army staff supported the proposal as did General Palmer, now the vice chief, and Secretary Brucker approved it, also in October 1955. Gavin, moving laterally from the post of deputy chief of staff for plans and research, became the first chief of research and development in the new structure.[55]

Lt. Gen. James M. Gavin, chief of research and development, U.S. Army, 1955–1958. Courtesy, Personality Photograph Collection, U.S. Army Military History Institute.

Although the Office of the Chief of Research and Development had secured independence and equality on the Army staff, it still did not exercise complete control of the Army's research and development program. The historian most familiar with the evolution of the service's research and development organization during this period notes a persisting organizational dichotomy: "As a result [of the change], the Chief of R&D was clearly responsible to the Chief of Staff for research and development, yet the Deputy Chief of Staff for Logistics controlled and directed the Technical Services which carried out the program. That a lack of responsiveness by these services to the Chief of R&D could exist under this arrangement became evident. These services were supposed to obey two masters, with primary allegiance naturally flowing toward their source of command—DCSLOG."[56]

The independent role exercised in some aspects of research and development by the Continental Army Command, successor to the Army Field Forces, further fragmented management of the Army's research and development program.[57] In the mid-1950s, the command's responsibilities in this area included the "determination of requirements and the recommendation of military characteristics" for new equipment. Additionally, it conducted service testing, part of the "user" phase of the Army's testing regimen, through the several test boards under its command.[58] Although the chief of research and development had policy cognizance on the Army staff both for requirements and service testing, his office did not control funds for the latter. In mid-1957, Lieutenant General Gavin's deputy, Maj. Gen. Andrew P. O'Meara, who viewed the Continental Army Command as an unnecessary intermediate headquarters that delayed acquisition of new systems in the testing phase, recommended that the test boards be removed from the command and placed directly under the chief of research and development.[59] Others in Gavin's office thought it would be sufficient to gain control of the funds for service testing to make the Continental Army Command more responsive and to reduce delays.[60]



Adapted from Chart 11, Presentation of Rear Adm. T. C. Lonnquest before the Board to Study and Report upon the Adequacy of the Bureau System of Organization, 14 February 1956, box 21, Op-00 Files (1956), OAB, NHC.

The Roderick Board

While pleased with research and development's elevated and independent status, some on the Army staff and their scientist supporters remained dissatisfied with an outcome that still left authority for the service's research and development program divided. Their ultimate goal was to secure its unified direction. Richard S. Morse, who became chairman of the Army Scientific Advisory Panel in 1958, was especially determined to achieve this objective. Since 1940, he had been president of the National Research Corporation, a pioneer in the field of high vacuum technology, and was also a member of the Defense Science Board.[61]

In late October 1958, following the Soviet space achievements and subsequent reorganization of the Department of Defense that provided for increased central control of the services' research and development programs under the director of defense research and engineering, the Scientific Advisory Panel made several recommendations to the secretary of the Army who was looking to cut the length of the weapons development cycle. Most involved the Army's organization for research and development: establishing an assistant secretary position responsible exclusively for research and engineering; awarding the post of chief of research and development the rank of deputy chief of staff; and giving that official control of all research and development funds, including those involving test and evaluation. A year later, only the proposal to give the chief of research and development control of all R&D funds looked like it might be realized.[62]

In the meantime, in the spring of 1959, Morse succeeded Martin as director of research and development in Secretary Brucker's office. From this position he was able to exert much greater influence on Army research and development. In October, he proposed that he head a board to study the Army's R&D organization. Lt. Gen. Arthur G. Trudeau, who succeeded Gavin as chief of research and development, supported the idea. But General Lemnitzer, now the chief of staff, disagreed that Morse should be the board's chairman, perhaps because the scientist was known to favor radical organizational change. Accommodating Lemnitzer's wishes, at the end of November Secretary Brucker appointed a board chaired by George H. Roderick, the assistant secretary of the Army for financial management, to conduct the review.[63]

Over the next six months, the Roderick Board considered three principal courses of action. The first was a reorganization plan that amounted essentially to the status quo with relatively minor changes. The second, presented by Morse, was to establish a single development command similar to the Air Force's Air Research and Development Command. This alternative had unstated but obvious implications—the effective dissolution of the technical services. Lieutenant General Trudeau, who believed that major changes to the technical service structure would be too disruptive, advocated a third option. He sought to increase the authority of the chief of research and development by gaining control of the technical services' R&D funds and personnel, but within the existing organizational framework.[64]

In July 1960, the Roderick Board adopted the approach advocated by Trudeau. Its principal recommendation proposed establishment of a direct line of authority from the chief of research and development to the technical services, parallel to that from the deputy chief of staff for logistics, that would give his office control over the technical services' R&D funding and personnel. Secretary Brucker, who also opposed departmental restructuring, quickly approved the changes.[65]

The technical services had survived, but their independence, diminishing over the decade, had been further eroded. General Lemnitzer assembled the technical service chiefs to inform them of the secretary's decision. Cautioning the generals not to adopt a defensive attitude toward the changes, he said that they must provide their wholehearted support to the decision and ensure that within their organizations there would be no bickering, prolonged argumentation, or foot-dragging.[66] For his part, Lt. Gen. John H. Hinrichs, the chief of ordnance, seemed optimistic: "the realignment can be made to work to our advantage, not only from the standpoint of Ordnance, but better service to the Army as a whole."[67]

Despite the greater centralization of research and development oversight, the management of Army acquisition remained divided: between the deputy chief of staff for logistics and the chief of research and development, and, among the Army staff, the Continental Army Command, and the technical services. This fragmentation made it difficult to integrate and coordinate the Army's acquisition effort. This was especially true for systems that involved the participation of more than one of the technical services.

The acquisition of the Mohawk, a light, fixed-wing observation and surveillance aircraft, illustrates the problem presented when a program lacked central direction and a means to integrate subsystems that cut across commodity boundaries. Mohawk began development in 1954 as a joint Army-Navy venture. Two years later a joint-service board selected Grumman Aircraft as the development contractor. But in 1958, citing high costs and differing priorities, the Navy withdrew, leaving the Army to proceed alone. Three technical services were involved in Mohawk: the Transportation Corps was responsible for the airframe-engine combination, the Signal Corps for the aircraft's electronic equipment, and Ordnance for its armament. None of the three, however, had the authority to define the aircraft's technical characteristics for the contractor. In 1959, Grumman indicated that it did not know exactly what the Army wanted. The Transportation Corps attempted to bring the program together but encountered resistance from the other technical services and elements of the Army staff. Multiple funding sources also delayed progress. The aircraft finally entered service in 1961, and in spite of the organizational roadblocks the service had put in its way and the subsequent time lost, Mohawk proved to be a successful system.[68]

Courtney Johnson, assistant secretary of the Army for logistics, was one of those who perceived fundamental flaws in the service's acquisition structure. In late 1960, he told the chiefs of the technical services that the Army's procedure for "getting major items ready for procurement . . . had us in a position where we never would get a new major item into the system. With CONARC [Continental Army Command], R&D [Office of the Chief of Research and Development], and LOG [Office of the Deputy Chief of Staff for Logistics], and others involved in the test, correction, and re-test cycle, it practically guarantees that the major item will never be put into production."[69]

THE ATTACK ON LEAD TIME

In the wake of the two Sputniks, concern about the disparity in weapon systems lead time between the Soviet Union and the United States that had prompted the Robertson committee study in late 1955 resurfaced both in Congress and in the Department of Defense. The Army, which had not been much involved in the previous activity, launched a major campaign to reduce cycle length for its systems. As with the earlier movement to increase the authority and organizational status of research and development, the Army Scientific Advisory Panel took the lead, but with mixed results. The focus on reducing lead time resulted in a greater emphasis on employing concurrency in the acquisition cycle, particularly with respect to test and evaluation. But whether that and the other measures taken actually shortened weapon system lead times seems doubtful.

The Scientific Advisory Panel Gets Involved

The Army had been represented on the Robertson committee's weapons-cycle study groups in 1955 and 1956, but largely as an observer because the committee was tasked to investigate only manned, fixed-wing Air Force and Navy systems. Even so, probably not wanting to be seen as simply a bystander, the Army indicated that many of the committee's findings were relevant to its own systems, aircraft or otherwise, and identified steps it had taken to reduce lead time. The Army's short three-page report, however, had mostly a "me-too" flavor—long on actions the service was considering but very short on implementation of specific measures recommended by the Robertson committee.[70]

With Soviet satellites suddenly orbiting overhead in the fall of 1957 and Americans fearful about the adequacy of their military programs, the Army began to take a much greater interest in the lead-time problem. At the end of October, Frederick L. Hovde, the president of Purdue University and chairman of the Army Scientific Advisory Panel, wrote Secretary Brucker urging that the Army support steps to improve the management of science and technology for national defense. He believed, for example, that a better decision-making procedure would enable the Army "to support projects at optimum rates and reduce time lag between the conception and use of new weapons."[71]

The next year the Scientific Advisory Panel focused directly on weapons-cycle length. In May 1958, it organized a subpanel on R&D management that considered ways of shortening development time.[72] That issue was the theme of the meeting of the entire panel in Colorado Springs, Colorado, at the end of October. As previously described, Richard Morse, who succeeded Hovde as chairman, submitted the Scientific Advisory Panel's recommendations for reducing lead time to Secretary Brucker. Most involved strengthening the Army's R&D management, especially by increasing the organizational status and authority of the director of research and development in the Army secretariat and of the chief of research and development on the Army staff. With respect to the conduct of critical programs, the panel suggested that "the project management system should be more widely adopted with clear delegation of authority to a single project officer." Finally, in a recommendation that would eventually find its way into an Army regulation, the panel identified an appropriate weapons development time frame: "The decision to proceed with a development project . . . should be so timed that a program of <u>less</u> than four years can be scheduled and subsequent changes in scope and design reduced to a minimum."[73] Why did the Scientific Advisory Panel settle on a four-years-or-less cycle? It's likely that the time frame was based on testimony presented by Major General Medaris, commander of the Army Ballistic Missile Agency, to the Senate's Preparedness Investigating Subcommittee earlier in the year. In response to a question from Sen. Estes Kefauver (D-Tenn.) about cutting cycle length, Medaris replied: "Well we are going to have the Jupiter in the field . . . 3 years after we got the job. I think this is a little exceptional, but I will tackle any system on a 4-year cycle. . . . Four years, I would say, is a reasonable objective that can be met."[74]

The Lead Time Symposium

In early December 1958, the Office of the Chief of Research and Development sponsored an Army-wide symposium at the Pentagon to address weapons-cycle length. Nearly 100 Army officials, including William Martin, the director of research and development, and 25 general officers, attended the two-day meeting. Among the flag officers were the commander of the Continental Army Command and the chiefs of four of the seven technical services. Several members of the Scientific Advisory Panel were also present. The historical record does not reveal a direct connection between the event and the panel's recommendations concerning lead-time reduction that had been transmitted to the secretary of the Army in October, but it seems safe to speculate that a causal relationship existed between the two. The large number of high-ranking participants by itself indicates interest at the highest levels of the Army. Unlike many symposia, the conference would be more than a forum for expressing views: many of the proposals for reducing lead time would be incorporated in a new version of the Army's research and development regulation.[75]

Lieutenant General Trudeau, the chief of research and development, welcomed the symposium attendees. He noted military technology's importance to national survival, but also pointed out that technical competence would not be sufficient if its fruits were not timely. In the United States, he said, weapons lead time was too long. It ranged from 8 to 15 years, with the norm being 10 years. In contrast, the Soviet average for fielding new systems was 5 years. He asserted that "[t]he most critical single factor . . . in defense against the Soviets, is a reduction in the United States' weapons system lead time." Therefore, he had organized this symposium to identify broad problem areas and specific stumbling blocks in the Army's research and development cycle—"from wanting to getting" or "womb to boom," as he put it—and to come up with courses of action to help solve them.[76]

Lt. Gen. Arthur G. Trudeau, chief of research and development, U.S. Army, 1958–1962, with Army Courier communications satellite.
Courtesy, Arthur G. Trudeau Photograph Collection, U.S. Army Military History Institute.

Trudeau suggested that lead-time reductions might be found in several areas. One was management, especially decisions about continuing or terminating specific projects and determining when to freeze system designs. Another was internal administrative procedures, particularly those related to the budgeting process. He placed special emphasis on cutting lead time by increasing concurrency. The pace of the technological race with the Soviets demanded it, he said. According to Trudeau, design for production should be introduced early in the development cycle. He also believed that telescoping the Army's testing protocol "must become the rule rather than the exception."[77]

Symposium participants generally agreed that greater use should be made of concurrency. Citing its apparently successful application in the Hawk surface-to-air missile program, an officer from the Ordnance Corps declared that "Telescoping is feasible—in fact, is mandatory—if we want to produce weapon systems with a future."[78] Col. D. M. Simpson, from the Office of the Deputy Chief of Staff for Logistics, also cited the Hawk program, noting that preproduction engineering had been introduced in the third year of a projected six-year development cycle, resulting in the early delivery of prototype and production missiles. But he also indicated that preproduction engineering activities were the exception rather than the rule and normally carried out only in missile and aircraft programs: "DCSLOG does not consider that the engineering design phase can be materially shortened. The old saying, 'If you want it bad, you get it bad,' is most applicable in this instance. Items production-engineered in haste are, almost without exception, difficult to produce and maintain. They are under constant modification while in the hands of troops in order to correct deficiencies."[79]

William Martin, the Army's director of research and development, also emphasized the need to apply concurrency but placed it in the context of the systems approach to acquisition management. He argued that to obtain an acceptable major weapon system in minimum time—"four years or less for important weapons"—numerous criteria must be met. Several that he identified ran counter to the Army's established approach to acquisition. One criterion was that the same agency should be responsible for development, preparation for production, and production. Yet in the Army of the late 1950s, although the technical services carried out all phases of the acquisition cycle, responsibility for acquisition policy guidance on the Army staff was divided between the chief of research and development and the deputy chief of staff for logistics, the latter having cognizance over production. Martin also held that a "project manager" in the developing agency should be responsible for the acquisition of each major system. Moreover, in Martin's view, since development extended well into production, the project officer should come from the research and development side of the organization.[80] Yet, other than in certain missile programs and in the Chemical Corps, the functionally organized technical services had not adopted the project officer concept.[81]

The notion that the Office of the Chief of Research and Development should be the manager of weapon system acquisition well into production provoked one of the two major disagreements at the symposium. DCSLOG's Colonel Simpson countered that it made more sense to divide staff responsibility between research and development and logistics at the conclusion of engineering testing, the final phase of testing conducted by the technical services. He suggested that an item could be accepted by the user and then not be producible or only produced in token quantities because of high costs.[82] The dispute, of course, reflected the debate in all the services since World War II over the boundary between research and development and production.

Proposals to apply concurrency to testing generated the symposium's second significant controversy. The testing protocol then in effect was sequential. The technical services conducted "engineering" tests to determine if the system met "technical characteristics." The Continental Army Command, representing the user, then performed "service" tests that assessed the equipment's suitability for field use, particularly whether it performed according to its specified "military characteristics." By the time of the symposium, the governing Army regulation provided for deviations from the normal sequential pattern. Engineering and service tests might be combined in one of two ways. In "consolidated" testing, the developing and using agencies would jointly conduct the engineering and service tests; in "concurrent" testing, the two would perform the tests independently but at the same time. The chief of a technical service or the Continental Army Command might recommend, or the chief of research and development on the Army staff might direct, that one of the two alternatives be followed.[83]

Most at the symposium supported greater use of either of the two forms of simultaneous testing. An Ordnance Corps officer declared that the sequential approach "takes far more time than the enemy and advancing technology will permit. Let's face it! R&D is an activity more closely related to Las Vegas than to the Chase National Bank. By using this system, risks are certainly minimized, and built-in obsolescence is just about as certainly guaranteed."[84] The Continental Army Command, while not opposed to simultaneous testing, preferred the traditional series procedure. But if tests had to be combined, then the command definitely favored concurrent over consolidated testing because engineering and service tests had such different objectives and were executed under such different circumstances that they could not take place together successfully.[85]

Wilbur Payne, the representative from the Operations Research Office at Johns Hopkins University, under contract to the Army since 1948, added a measure of realism to the discussion over the merits of combined engineering and service tests. He summarized the findings of a study, recently completed by the Operations Research Office, on the relationship between these tests and research and development lead time. It revealed that the period from the start of engineering tests to the end of service tests accounted for no more than 15 percent of the total time required for a weapon system to go from concept to inventory. Furthermore, not all of this time was consumed by testing; it also encompassed the time required for system redesign and modification based on deficiencies disclosed by the tests. In some cases, he noted, testing downtime was as much as 50 percent of the total testing period. Additionally, in most of the cases studied, engineering and service tests overlapped with other phases of the cycle, including instances when production started very early. Thus, the degree "to which engineering and user tests have delayed operational availability—which is the real measure of their impact on overall lead time—is much less than the 15 percent figure would indicate." Nonetheless, concluded Payne, although major savings would not be realized, combined testing would reduce lead time, particularly if the two different agencies carrying out the tests coordinated more effectively.[86]

In all, the symposium deliberations produced approximately 120 recommendations to shorten lead time, and Trudeau formed an ad hoc committee to evaluate them for possible implementation.[87] Significantly, its membership included only representatives from his office and one from the Continental Army Command.[88] The deputy chief of staff for operations, the deputy chief of staff for logistics, and the chiefs of the technical services had declined to participate.[89]

Trudeau's ad hoc committee submitted its report in early March 1959, incorporating lead-time reduction measures in a draft revision to the Army's regulation (AR 705-5) that covered research and development and had been issued in September 1958. Most of these were procedures for expediting development and for selecting systems to be developed, and amounted to streamlining rather than bold change.[90] Curiously, the draft regulation offered nothing new with respect to combined testing; that area proved virtually identical to the 1958 regulation.[91]

The Scientific Advisory Panel's management subpanel praised the ad hoc committee's work, but expressed concern "about the complex matrix of agreement which must be established before the recommendations can be put into effect."[92] The difficulty of securing consensus among the various agencies with roles to play (and vested interests to protect) in Army acquisition was underlined by the length of time required to obtain approval for the new regulation—it was not issued until the end of December 1959.

Disagreement over testing appears to have been at least one issue extending the Army staff's review process. The ad hoc committee's draft, like the 1958 regulation, simply allowed for combined engineering and service testing and authority for the chief of research and development to direct its use. But the final version of the new regulation went further, nearly mandating simultaneous testing: "[E]ngineer and service testing will be conducted jointly wherever such a procedure will not manifestly jeopardize the validity of the tests or concurrently where the availability of test items and facilities will permit."[93]

Institutionalizing Concurrency

The new research and development regulation notwithstanding, Courtney Johnson, the Army's assistant secretary for logistics, did not believe enough was being done to cut lead time. In late December 1960, he suggested to the secretary of the Army, the chief of staff, and the vice chief of staff that the matter needed to be considered anew. Early in January 1961, he told the chiefs of the technical services that the most important problem then facing the Army involved the length of time it took to bring an idea to the stage where the resultant weapons or equipment were ready for issue to the troops. He was particularly critical of the Army's elaborate and lengthy testing regimen.[94]

Johnson had only a few days left in office; his place would soon be taken by a Kennedy administration appointee. Nonetheless, the vice chief of staff assured him that a cold, hard look would be taken at the whole process. And, in a reflection of the Army's traditional subordination to civilian control—even when it might not have mattered—the chief of staff charged the Materiel Requirements Review Committee to study the lead-time problem.[95]

Originally established in 1951, the Materiel Requirements Review Committee recommended policies and priorities to the chief of staff regarding major items of equipment that, if procured, might severely impact the U.S. economy, that were controversial, or that might result in changes in organization or tactical doctrine. Chaired by a general officer from the Office of the Deputy

Chief of Staff for Operations, the committee included general officers from the offices of the deputy chief of staff for logistics and the chief of research and development. General officers from the Office of the Comptroller and from the Continental Army Command participated as advisers. The technical services were not represented.[96]

The Materiel Requirements Review Committee submitted its report to the chief of staff in August 1961. Based on its study of 23 Army systems, the committee found an average lead time of 10 years and 10 months.[97] At the root of long lead times was the Army's basic philosophy regarding the acquisition of materiel:

> This approach is oriented to produce a well-tested item of proven capability, durability, and reliability. Product improvement is the basic direction of our efforts. . . . This attitude produces improved products, but it also tends toward 'nice-to-have' qualities that add to the cost and lead time. This procedure [increases] lead time by virtue of its primary emphasis on methodical development and test of materiel under the auspices of the technical services followed by exhaustive tests by the user. In this procedure, time is of secondary importance.[98]

The committee criticized previous analyses of lead time as focusing too narrowly on RDT&E and giving only cursory treatment to operations and logistics. "Nothing is to be gained in developing items at an accelerated pace," it maintained, "unless operational concepts and personnel to man the item are available as the items come off the production line."[99] Another shortcoming, asserted the committee, was "the timidity of the actions which have been taken to . . . cut lead time."[100] Given the Soviets' average of five years lead time to field new systems, the objective must be to "reduce to *four years or less* the time required from a project's initiation to the roll off of first production materiel that offers a significant new capability to the U.S. Army."[101] To achieve this goal, "drastic changes will have to be made in U.S. Army philosophies, procedures, organization and other aspects of our materiel program."[102]

To replace the existing product improvement approach, the Materiel Requirements Review Committee articulated a new philosophy for Army acquisition. Its basic tenets were: (1) to make long-range objectives and plans for acquisition definitive and of sufficient duration to encompass the development and introduction of new weapons and other equipment; (2) to maintain strong research and subsystem development programs to provide the building blocks of system development and reduce the need for "invention on schedule"; (3) to measure requirements against "total feasibility"—an assessment not just of technical possibility but also of personnel, operational, and logistics factors; (4) to shorten development by "optimum" funding of projects, holding design changes to a minimum, and reducing test time; (5) to decrease production and distribution lead times by early concurrent preparations for production, accelerated production rates, and integrated programming; and (6) to clarify organizational responsibilities and take advantage of modern management methods.[103]

To implement the new philosophy and cut lead time, the Materiel Requirements Review Committee made numerous recommendations spanning the acquisition cycle from requirements formulation through system disposition. With respect to the Army staff, the most important were for the deputy chief of staff for operations to prepare a 20-year capabilities plan that would cover the personnel, fiscal, and material resources needed to meet each of the plan's objectives, and to design a system for establishing "meaningful" priorities among development programs. Additionally, the chief of research and development was to establish and chair "coordination groups" with representatives from the offices of the deputy chiefs of staff for operations and logistics, the Continental Army Command, and the appropriate technical service to manage major projects or groups of functionally similar minor projects. "Total feasibility" studies were to be completed early in the acquisition cycle. For their part, the technical services were to standardize program management systems, emphasize research and subsystem development, and initiate early production engineering to assure a smooth transition from research and development to production. The technical services and the Continental Army Command were to conduct engineering and service tests jointly.[104]

At the end of August 1961, General Clyde D. Eddleman, the vice chief of staff, approved most of the Materiel Requirements Review Committee's recommendations.[105] At the same time, he directed the committee to draft a regulation incorporating the recommendations for approval by the chief of staff. In what was likely record time for an Army regulation, especially one with such far-reaching implications, the new regulation was approved and published before the end of September (AR 11-25, Reduction of Lead Time).

One industry analyst claimed that the regulation represented the "formal acceptance and support of the development technique long used by the Air Force in its ballistic missile programs—the concept of concurrency."[106] He was only partly right. As described in chapter 4, the Army was no stranger to concurrency, having overlapped development with production extensively during the Korean War. Moreover, by 1961, most Army development projects were compressed to varying extents. In fact, all Army missile programs had been telescoped.[107] But these decisions pertained to particular systems and did not constitute Army-wide policy. What was new was the regulation's institutionalization of certain aspects of concurrency. Thus, for example, it mandated "early preparations for production" and "joint engineering and service tests" ("the rule rather than the exception").[108] Even so, the Army had not gone nearly as far as either the Air Force or the Navy's Bureau of Aeronautics when it came to concurrent development and production. Before

1955, the latter two had begun to require that production begin at a low rate before completion of development in order to have sufficient units available for testing. Only in early 1959 did the Army consider making a low rate of initial production service-wide policy. At that time, the deputy chief of staff for logistics decided to allow the practice, but it was not mandatory.[109]

The new regulation also made the objective of reducing lead time to four years or less from project start to initial production official policy. This idea, perhaps first planted in congressional testimony by Major General Medaris early in 1958, had been reinforced in the Army Scientific Advisory Panel's report to the secretary of the Army in October, and at the lead-time symposium in December by William Martin, the director of research and development. Despite the goal's widespread acceptance, there remained some skeptics within the Army. Following the symposium, Major General Hinrichs, the chief of ordnance, wrote Martin that, while he might accept four years as a general guide, "[w]hether four years, as you suggest, is applicable to <u>all</u> weapons or systems is questionable."[110] Concluding his presentation to the Materiel Requirements Review Committee in 1961, the representative from the Quartermaster Corps asserted that "[e]ven under a radically new approach with benevolent dictatorial powers concentrated in one staff element, lead time may only be compressed by more than a year or perhaps two at the most. Under no circumstances is it believed that it will be compressed by as much as 50 percent as some seem to believe."[111] The cautionary notes proved to be prescient. In March 1968, in a briefing to the Army Scientific Advisory Panel, an officer who was involved in the earlier work of the Materiel Requirements Review Committee reported that he was told that "today actual lead time is about what we found it at the start of our study, namely between eight to twelve years."[112]

MISSILE ACQUISITION AND INDUSTRY RELATIONSHIPS

In the late 1950s, according to Lieutenant General Trudeau, the Army "had not fully come to believe in the systems approach."[113] Certainly Trudeau was correct in that the weapon system concept was not Army policy, as it had been in the Air Force since early in the decade. Nor did its key features—central planning and direction, concurrency, a project-type organizational pattern, and the assignment of a predominant role to industry—characterize most or even a large number of Army programs. Nevertheless, the service had implemented or experimented with all of the concept's major elements to one extent or another. The variety of applications of the weapon system approach is evident in Army missile programs, particularly in the relative degree of responsibility granted to industry. Three programs—the Jupiter intermediate range ballistic missile, the Nike Ajax surface-to-air missile, and the Pershing medium range ballistic missile—illustrate the range of industry's participation in developing and producing the Army's missiles during the Eisenhower era.

Organizational Evolution

Until its dissolution in 1962, the Ordnance Corps acquired the Army's missiles and rockets. In late 1948, the chief of ordnance designated the Redstone Arsenal in Huntsville, Alabama, the center for missile and rocket research and development. Prior to that time, work on these weapon systems had taken place at the White Sands Proving Ground on the Fort Bliss military reservation that spread across Texas and New Mexico (mostly in the latter). At Fort Bliss following World War II, the Army located the 120 German scientists and engineers, including Wernher von Braun, who had come to the United States under Operation Paperclip. A year after Redstone Arsenal became the Army's missile and rocket center, the group of Germans, along with other Army scientists and engineers, moved to Huntsville. At Redstone they formed the nucleus of the Guided Missile Development Division of the arsenal's Ordnance Missile Laboratory. With von Braun as its director, the division's main task was to develop the 175 nm range Redstone ballistic missile.[114]

Major General John B. Medaris and Dr. Wernher von Braun.
Courtesy, U.S. Army Aviation and Missile Life Cycle Managemnt Command.

About two weeks before Secretary of Defense Wilson's directive of 8 November 1955 authorizing two IRBM projects, the Army staff, hopeful that the service would be assigned responsibility for one of them, drew up a plan and organizational structure for executing a development program, eventually designated Jupiter. The nature of the organizational arrangements engendered an internal debate at the highest levels of the Army staff that reflected the continuing struggle to control research and development. The initial proposal, presented by Lt. Gen. Carter B. Magruder, the deputy chief of staff for logistics, called for a new organization to develop the missile that would report directly to the chief of staff. Following a face-to-face protest from Chief of Ordnance Maj. Gen. Emerson L. Cummings, Magruder agreed that the organization should report through the technical service chief. But when Lieutenant General Gavin, chief of the newly independent Office of Research and Development, was presented with this arrangement, he objected, apparently arguing that his office should command the organization.[115]

The Army's uniformed leadership reached agreement after a series of meetings that took place between 22 and 25 October 1955. The attendees included General Taylor, the chief of staff; General Palmer, the vice chief; Lt. Gen. Laurin L. Williams, the Army comptroller; and Gavin, Magruder, and Cummings. Should the Army be assigned an IRBM program, it would establish the Army Ballistic Missile Agency (ABMA) and designate a commanding general. The new organization would be an element of the Ordnance Corps and be located at the Redstone Arsenal, but would not be part of the arsenal's organizational structure. On the other hand, the agency would be able to appropriate those elements—people and facilities—of the Redstone Arsenal that the missile organization's commander believed essential to its mission, namely von Braun's division. Although the Army Ballistic Missile Agency's nominal reporting chain would include the chief of ordnance, the deputy chief of staff for logistics, and the chief of research and development, its commander would have direct access to the chief of staff should that be necessary.[116] In a memorandum for the record detailing the course of events leading to the compromise, Major General Cummings wrote: "Although I would much prefer to handle this project through the regular organization of the Redstone Arsenal . . . I am confident that had I insisted on such a method of operation the project would arbitrarily have been withdrawn from Ordnance and handled directly by the Chief of R&D. It was for this reason and for this reason alone that I recommended the establishment of a second agency at Redstone Arsenal. . . .[117]

On 1 February 1956, the Army Ballistic Missile Agency, commanded by Maj. Gen. John Medaris, was formally activated with its core, the 1,600 personnel in von Braun's division, transferred en masse from the Ordnance Missile Laboratory.[118] The ballistic missile organization's highest priority was to develop the Jupiter IRBM, but work also continued on the medium range Redstone missile.

In March 1958, the Army consolidated its missile and rocket development operations into one field organization—the Army Ordnance Missile Command. Its components were the Army Ballistic Missile Agency, the Army Rocket and Guided Missile Agency, the Jet Propulsion Laboratory, and the White Sands Proving Ground. Medaris moved up to be the new organization's commander. In 1960, the command's total strength was approximately 19,500, about one-fifth military personnel. More than one-third, military and civilian combined, had scientific and technical backgrounds.[119]

Maj. Gen. John B. Medaris
Courtesy, U.S. Army Aviation and Missile Life Cycle Management Command.

Major General John B. Medaris (1902-1990)

With black mustache and swagger stick, Maj. Gen. John Medaris, who led the Army's missile and space program from 1956 until his retirement early in 1960, was a colorful figure. Born in Milford, Ohio, in 1902, Medaris served in the Marine Corps in France during World War I, received an Army commission through the Reserve Officer Training Corps after the war, was posted to the then-Ordnance Department, and resigned from the Army in 1927. Following ten years in merchandising and management advisory work, he returned to active duty in the Ordnance Department in 1939. During World War II, he carried out assignments as an ordnance officer in campaigns in Tunisia, Sicily, and on the European continent.

When selected to command the Army Ballistic Missile Agency early in 1956, Medaris was 53 years old, a brigadier general, and an assistant chief of the Ordnance Corps. Dr. T. Keith Glennan, the first administrator of the National Aeronautics and Space Administration, who successfully pried the von Braun group and the Jet Propulsion Laboratory from Medaris and the Army in 1959, later described him as "a martinet, addicted to spit and polish." Whatever the accuracy of that characterization, there is no denying the Army's space and missile achievements under Medaris' leadership. Among them were the first successful U.S. IRBM firing, the first U.S. satellite to achieve orbit, and the first living beings (the monkeys Able and Baker) to be recovered from a flight into space. He also developed the Jupiter IRBM for turnover to the Air Force in less than three years, and launched the Explorer I satellite within 90 days of being given the go-ahead. Although probably less well-known than his contemporaries, Maj. Gen. Bernard Schriever in the Air Force and Rear Adm. William Raborn, Jr., in the Navy, General Medaris' accomplishments were perhaps equal to if not superior to theirs. James Beggs, administrator of the National Aeronautics and Space Administration in the early 1980s, would say of him: "It occurred to a number of us, had it not been for Medaris and his organization, a lot of things that were done in the early days couldn't have been done."

Ten years after retiring from the Army, Medaris was ordained an Episcopal priest.[I]

Initially, the Army Ordnance Missile Command continued the program responsibilities already in place—the Army Ballistic Missile Agency for the longer range ballistic missiles (Redstone, Jupiter, and Pershing) and space activities, and the newly formed Army Rocket and Guided Missile Agency for the missiles and rockets that had belonged to the Redstone Arsenal.[120] A new division of responsibilities evolved over time. After the Army lost its space programs to the National Aeronautics and Space Administration in late 1959, the Army Ballistic Missile Agency managed surface-to-surface missiles and rockets that followed a predetermined or preplanned trajectory, essentially ballistic missiles.[121] The Army Rocket and Guided Missile Agency handled systems that were controlled or maneuvered after launch. Whether managed by either of the two organizations, the missile and rocket programs reflected three different relationship patterns with industry. [122]

Jupiter: The Arsenal Approach

Historically, the Army had largely designed, engineered, fabricated prototypes of, and tested new weapons and other equipment in its own facilities such as the Redstone Arsenal, staffed by uniformed and civilian government personnel. Under this so-called "arsenal concept," industry's primary role was quantity production of materiel designed and developed by the Army. Despite industry's increasing competence in weapons design and development and strong pressures to end government competition with the private sector after World War II, Army leaders continued to defend the arsenal system.[123] Medaris was foremost among them. He argued that facilities such as Redstone were not arsenals in the traditional sense but "great Army technical centers," repositories of specialized knowledge existing nowhere else. Their uniformed and civilian employees, responsible to the combat soldier and the taxpayer, channeled this knowledge exclusively into the needs of the fighting Army. Industry, looking first to its owner, the investing public, lacked the same "absolute single-mindedness of purpose." For this reason, said Medaris, the Army must be competent in every phase of the weapons cycle and be able to make decisions about it: "We can't have other people make those decisions for us, people over whom we have a lesser degree of control .

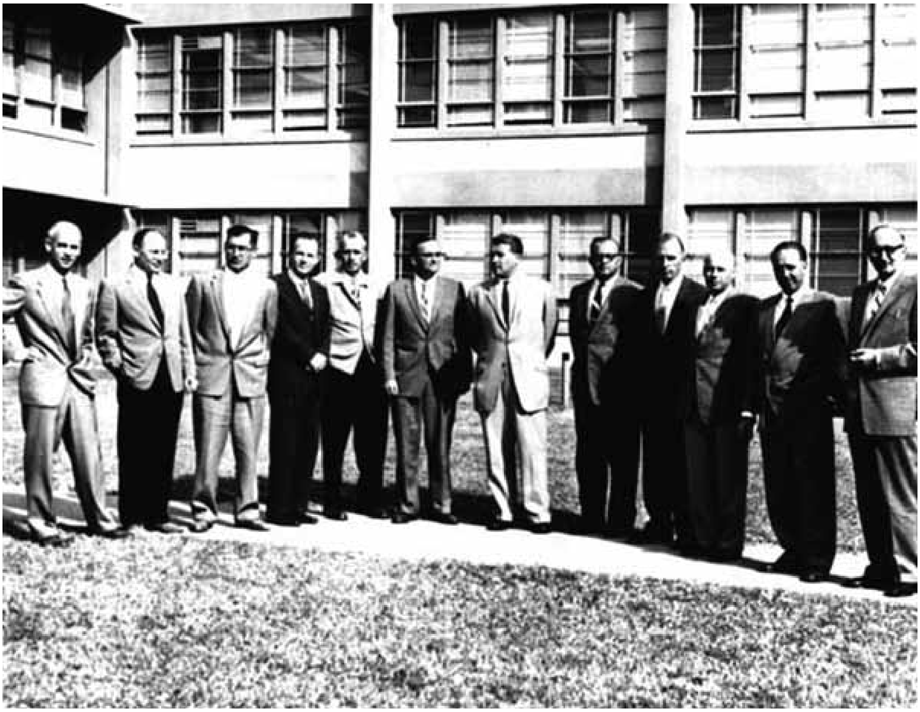
. . we must be in position to truly control our business."[124] In terms of the Army-industry relationship, acquisition of the Jupiter IRBM was both the apotheosis of the arsenal system and the antithesis of the weapon system concept as practiced by the Air Force. In other ways, however, the Jupiter program proved a model of the weapon system approach.

Jupiter IRBM launch, August 1958.
Courtesy, U.S. Army Aviation and Missile Life Cycle Management Command.

In line with the arsenal concept, the Army Ballistic Missile Agency, as the weapon system manager, performed most tasks related to Jupiter's design, engineering, prototype fabrication, and testing. Von Braun's Development Operations Division was responsible for technical direction and systems integration; through its several laboratories, the division bore the brunt of the missile's development work.[125] Unlike the Air Force and Navy, the Army did not award contracts solely for technical direction and systems engineering, although these functions were sometimes performed by the service's development and production contractors under its supervision.

By late 1956, von Braun's division had nearly doubled in size to almost 3,000 people. To control this large operation, von Braun employed a variety of innovative management tools. He required his key managers to give him weekly, one-page summaries of their activities called "Monday Notes." By the end of the week he had reviewed, commented on, and distributed those reports throughout the division. Von Braun also met regularly with the division's laboratory directors, largely the transplanted Germans. At these "Development Board" sessions, von Braun and the laboratory heads reached consensus on important technical and organizational issues affecting the Jupiter program.[126]

The Army Ballistic Missile Agency developed almost all of Jupiter's major subsystems and other components "in-house"; 70 percent, including the inertial navigation and guidance control system, came directly from or were improvements on those used in the Redstone missile.[127] An important exception, Jupiter's liquid-fuel, 150,000 lb. thrust engine—virtually the same engine being used for the Air Force's Thor—was a product of the Rocketdyne Division of North American Aviation in California.[128] But, despite the program's predominantly in-house character, at least 20 university and industry contractors participated in Jupiter's development phase.[129]



Top officials of the Army Ordnance Missile Command's Development Operations Division, June 1959. Dr. Wernher von Braun, its director, is sixth from right.
Courtesy, U.S. Army Aviation and Missile Life Cycle Management Command.

Although substantial in size, Medaris' organization lacked the people, the facilities in Huntsville, and the desire to use its highly talented development team to manufacture Jupiter. Therefore, the Army selected the Chrysler Corporation for this purpose.[130] It was a logical choice. The automobile company was the production contractor for the Redstone missile; many of that system's subsystems and other components as well as production engineering methods could be used in Jupiter. Moreover, as Medaris stated, we felt that we "could not go through the educational processes with another contractor. We couldn't afford [the time]. So Jupiter went automatically to Chrysler."[131] The missiles were produced in Chrysler's plant in Warren, Michigan, the same government-owned plant then manufacturing the Redstone.

With respect to Jupiter's major subsystems, the Army Ballistic Missile Agency had already identified and been working with production subcontractors during development.[132] In addition to North American for the missile's engine, the others were the Ford Instrument Division of the Sperry Rand Corporation for guidance and control assemblies, and the Goodyear Aircraft Corporation for the reentry vehicle.[133] So that the Army Ballistic Missile Agency could keep Jupiter on schedule, Chrysler was required to use the same firms that the Army selected to be principal subcontractors. This would assure that the production groundwork laid during the development phase would transfer to quantity manufacture without any decline in subsystem quality.[134] Otherwise, Chrysler had considerable latitude in subcontractor selection. For Redstone and Jupiter combined, the firm employed over 2,400 subcontractors and suppliers from 1 October 1956 through 1 September 1958.[135]

To compress the acquisition cycle as much as possible, the Army Ballistic Missile Agency brought Chrysler and the principal production subcontractors very early into the development phase. As with Redstone, Chrysler located a group of its people at Huntsville to work with von Braun's team, initially 26 of the company's top research and development engineers. Eventually Chrysler's contingent grew to 650 people.[136] According to Medaris, their presence on site was enormously important: "They looked over the shoulders of the designers and developers. They were mutually exposed to the user's influence. They contributed their expert knowledge in production engineering and tooling aspects. They became thoroughly conversant with the approaches, methods, and techniques developed in ABMA."[137] In Medaris' view, delivery of assembly line missiles direct to launching sites and their successful firing both by engineering teams and by troops demonstrated the value of introducing production contractors at the start of development.[138]

In the Chrysler-Army relationship, Medaris did not hesitate to let the industrial concern know who was in charge. Early in March 1956, when Jupiter was still a joint Army-Navy program, Medaris met with several Chrysler representatives in his office. He was concerned that the Navy and Chrysler (also a Navy contractor on the project) might team up to force changes in the missile—the Army's responsibility. "ABMA is the Agency," he declared, "that has technical cognizance; that the final product built for the Navy is built under technical cognizance of the ABMA; that the rest of the Navy job—launching and handling, ship borne use—that is strictly Navy-Chrysler."[139]

Aside from the degree of responsibility granted to industry, the Jupiter program followed the weapon system approach. It was centrally directed from conception through delivery. It proceeded according to a coordinated plan that treated design, engineering, testing, production, and field support as a single problem.[140] It employed concurrency throughout system acquisition. With respect to concurrency, as noted previously, production activities under way before development was complete. Also, coincident with project initiation, the Army Ballistic Missile Agency began planning for development of ground support equipment and troop training. But the long period of uncertainty about whether the Army would operate the missile that culminated in the decision to turn it over to the Air Force, and the subsequent difficulties in coordinating requirements with that service, caused work on ground support equipment and training to be delayed until early 1958.[141] Finally, in accordance with the weapon system concept, Medaris organized his staff in a project-type structure that included specialists from the various technical services and from other Army agencies. In the fall of 1957, 25 percent of the Army Ballistic Missile Agency's military personnel came from technical services other than Ordnance and 25 percent from the combat arms.[142]

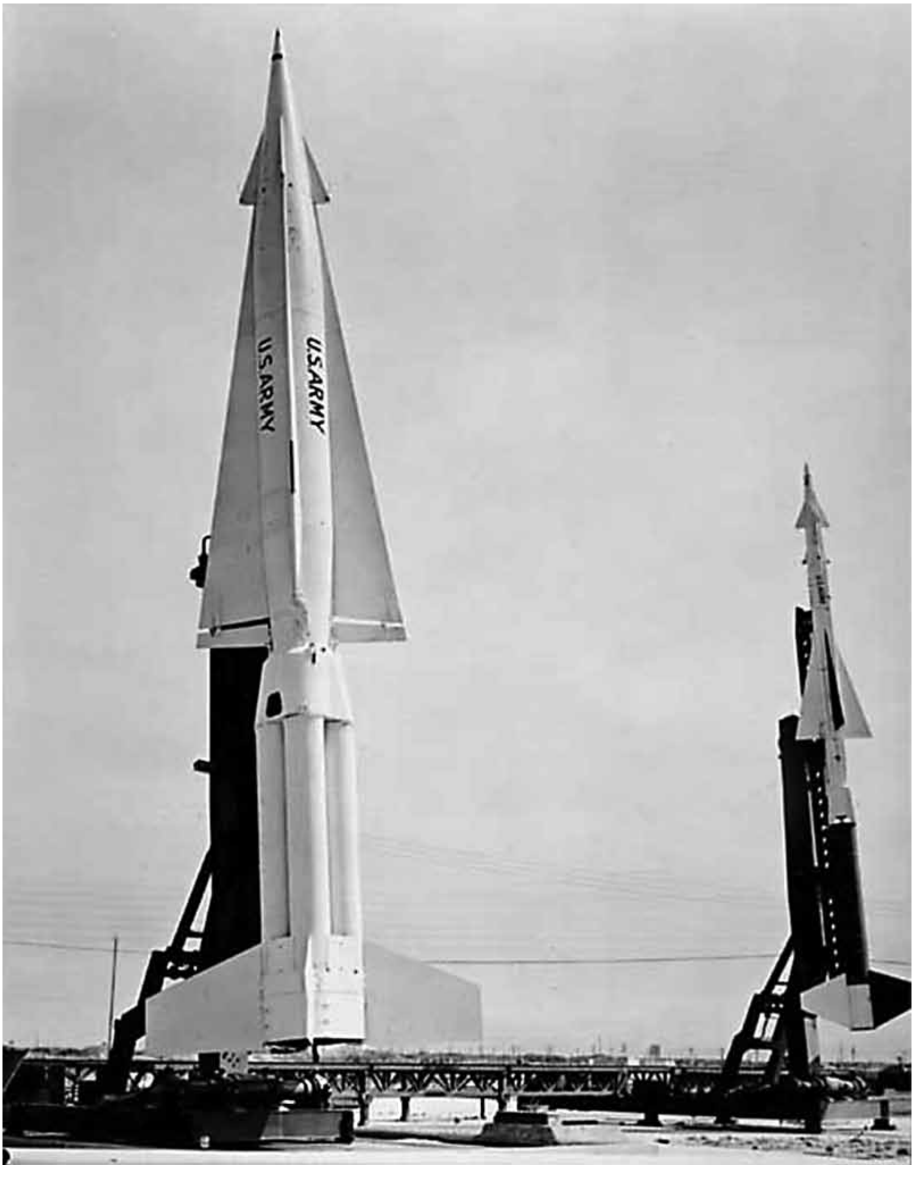
Like Schriever and Raborn, his counterparts in the other services, Medaris received special delegations of authority that enabled him to short-circuit the normal, time-consuming approval channels. For example, he was permitted direct access to the chief of staff and to the secretary of the Army and, on his own authority, could dispense with established technical service chains of command to get work accomplished.[143]

The Jupiter program was highly successful. Authorized in November 1955, it launched the first U.S. intermediate range ballistic missile just over eighteen months later. In August 1958, within three years of program start, the first deployment-ready missile was turned over to the Air Force. By July 1960, the first of ten Jupiter launch sites became operational in Italy under control of the Italian Air Force.[144] Lieutenant General Hinrichs, the chief of ordnance, believed that one of the lessons to be drawn from the program was its validation of the arsenal concept: "[S]trong management and engineering competence in-house must be maintained in order to properly direct and control contractors, with a view to both the development and production of sound missiles and the hold-down of costs."[145]

Nike Ajax: Single Prime Contractor

The Air Force's B–58 bomber program is usually credited with introducing that aspect of the weapon system concept in which a single prime industrial contractor, in this case Convair, received most of the responsibility for a system's acquisition. Actually, the distinction should go not to the Air Force but to the Army in the development and production of the Nike Ajax surface-to-air missile from 1945 through 1958.[146] Although it exercised overall program control and surveillance, the Army assigned both development and production responsibility for the system to the Western Electric Company and its research and development arm, the Bell Telephone Laboratories.

The principal reason for not using the arsenal system was that when the initial research and development contract was awarded in September 1945, the Army lacked an in-house capability to manage a guided missile program. Bell Laboratories, however, had already conducted a surface-to-air guided missile feasibility study for the Ordnance Department and the Army Air Forces during the war and was a leader in electronics, particularly in radar and computers, essential components of an antiaircraft missile system.[147]



Nike Hercules (left) and Nike Ajax surface-to-air missiles on launchers.
Courtesy, U.S. Army Aviation and Missile Life Cycle Management Command.

The Army granted extraordinarily broad authority and responsibility to Western Electric/Bell Laboratories in the Nike program. Although the service established the missile's required military characteristics, it afforded the company virtually a "blank check" with respect to program management. To oversee the program, the Army set up liaison offices at the contractor's facilities and monitored results rather than technical details.[148] For its part, Western Electric/Bell Laboratories undertook to supply the complete system—missiles, handling and launching equipment, and personnel training. It provided technical direction, had responsibility for system integration, and selected and oversaw the subcontractors. Additionally, it designed the radar, communications, and guidance systems, and manufactured many of Nike's electrical components.[149]

Western Electric/Bell Laboratories' major subcontractor, in fact almost an equal partner in the venture, was the Douglas Aircraft Company of California. Like Bell Laboratories, it had experience in guided missiles, working under the sponsorship of the National Defense Research Committee during the war. Douglas performed aerodynamic studies for Nike, supplied the missile airframe and launching equipment, and conducted the proving ground firing tests. Eventually, the company built 13,714 Nike Ajax missiles at its plant in Santa Monica and at the Army Ordnance Missile Plant in Charlotte, North Carolina. Douglas subcontracted Nike Ajax's solid-fuel booster and liquid-fuel sustainer engines to the Aerojet Engineering Corporation, also of California.[150] In 1954, the Nike system involved over 1,000 subcontractors and suppliers in 20 states.[151]

Nike Ajax missiles being assembled.
Courtesy, U.S. Army Aviation and Missile Life Cycle Management Command.

Elements of the Army's in-house network had important roles in the Nike Ajax program, acting essentially as subcontractors. Caltech's Jet Propulsion

Laboratory, under contract to the Army, assisted Douglas and Aerojet in solving propulsion problems. The Army's Ballistics Research Laboratory at the Aberdeen Proving Ground in Maryland worked on warhead configuration, its Picatinny Arsenal in New Jersey on development of the high-explosive warhead fragmentation device, and its Frankford Arsenal in Pennsylvania and Diamond Ordnance Fuze Laboratory in Connecticut on safety and arming mechanisms.[152]

From its inception through 1950, the Nike Ajax program proceeded deliberately. The first missile launch took place at the White Sands Proving Ground in September 1946, but technical difficulties slowed system development. In late 1950, in the emergency atmosphere created by the Korean War, enough progress had been made to convince K. T. Keller, President Truman's missile "czar," that Nike Ajax should enter quantity production (see chap. 3). Although development was not complete, the Army awarded contracts to Western Electric/Bell Laboratories and Douglas for 1,000 missiles to be manufactured by the end of 1952. In the meantime, in November 1951, a Nike had intercepted a drone.[153] In December 1953, just over two years later, the first Nike missile battery was declared to be operational, the first U.S. guided missile of any kind to achieve this status.[154]

In an interview in 2006, Frederic Scherer, co-author with Merton Peck of the pioneering study *The Weapons Acquisition Process* (1962), and author of the Nike missile family case studies that were part of the Harvard Graduate School of Business Administration's project that led to the book, remarked that Bell Laboratories contributed significantly, not just to Nike Ajax but to the methodology of weapons development generally. Bell's innovation, he suggested, was to say at the program's outset: "What does the state of the art allow? What does the state of the physical parameters allow? What can we reasonably achieve at reasonable cost in a reasonable time frame? What is just too difficult?" Nike Ajax, he thought, was "the supreme early manifestation of bringing this kind of approach to a weapons program."[155]

Nike Ajax was not an isolated instance of Army use of the single prime contractor. During the 1950s, the Ordnance Corps employed this management pattern in several other missile systems, including Nike Hercules, Nike Zeus, Lacrosse, and Hawk.[156]

Pershing: A Halfway House

Major General Medaris realized that new high-priority programs would likely follow Jupiter but that the Army's in-house resources were limited. If the Army Ballistic Missile Agency hoped to pursue those programs, especially the glamorous space projects, he would have to turn increasingly to industry and to the universities for help. In late 1957 he told his staff: "We must learn to utilize outside agencies to do much of the design, development, and fabrication, and yet properly control these operations. ABMA will still have the overall systems responsibility and therefore must retain a close check on what is done toward development of the system as a whole. Other agencies, however, may do the detailed work."[157] Medaris implemented this kind of Army-industry relationship in the Pershing program. It represented something of a half-way point between the arsenal concept that developed Redstone and Jupiter and the industry-centered approach employing a single prime contractor that characterized Nike Ajax.

Since late 1956, the Army Ballistic Missile Agency had been studying the feasibility of a medium-range surface-to-surface missile to succeed Redstone.[158] In contrast to its liquid-fuel, 175 nm range predecessor, the two-stage system that became Pershing would have a solid propellant (making it easier to handle and more mobile) and be able to reach targets 400 nm distant. In the first week in January 1958, the Army received approval to develop Pershing, and the Army Ballistic Missile Agency immediately began program planning. In a meeting with his staff on 16 January, Medaris laid out guidelines for the program:

> Therefore we are going into this system after having first looked all the way down the line. We are going to consider the form and shape of the troop organization, of the ground equipment set, of the warhead choices that present themselves, of the state of the art in solid technology before we make one move, cut one piece of metal, or let one contract. . . . Furthermore, the plan, when completed, will envisage a greater percentage of out of house operations than we have had on past missile systems. This does not mean we are going to put out a system contract. We are not. It does mean, however, that our make and buy choices in the development area [i.e., whether to develop subsystems and other components in house or to contract for them] will be made as part of the plan and nothing will be done until those choices are made and confirmed.[159]

From this initial planning emerged a conservative development approach. The Army Ballistic Missile Agency drew up the system's design concept and maintained tight control of the program by reserving to itself the role of systems manager with responsibility for technical direction. An industrial contractor assumed "*most* of the role of system prime developer." But the contractor's freedom of choice with respect to design was limited. As much as possible, Pershing was to depend on proven subsystems and other components. Particularly concerned to avoid risks with the missile's inertial guidance system, the agency decided to develop that subsystem in house. It was to be only an incremental advance over Jupiter's guidance system, smaller in size and with improved accuracy. Finally, Medaris' organization would require the prime contractor to obtain its approval before choosing major subcontractors.[160]

The process of selecting a prime contractor for Pershing moved quickly. From a list of 121 potential contractors, the Army Ballistic Missile Agency chose 7. Furnished with the system's preliminary design and military characteristics, each was invited to present its plan for producing Pershing to the agency's Procurement Advisory Board in early March 1958. The board, evaluating both the presentations and the agency's knowledge of each firm's capabilities, recommended the Glenn L. Martin Company of Orlando, Florida, to be the prime contractor for Pershing.[161]

Army Pershing (left) and Redstone ballistic missiles.
Courtesy, U.S. Army Aviation and Missile Life Cycle Management Command.

On 28 March 1958, the Army awarded a cost-plus-fixed-fee letter contract to Martin for $10 million for development and initial production of the Pershing system. Under the contract, the company would carry out research and development (including testing), reliability assurance, and production of the missile and its ground equipment. It would also supply training as well as engineering, maintenance, and other field support.[162]

As prime contractor, Martin, with the approval of the Army Ballistic Missile Agency (the Army Ordnance Missile Command after 31 March 1958), selected the system's major subcontractors. These included the Thiokol Chemical Corporation for propulsion, the Eclipse-Pioneer Division of Bendix Aviation for guidance system manufacture, the Bulova Watch Company (under the technical supervision of the Picatinny Arsenal) for the warhead adaption kit, and Thompson Products (later Thompson-Ramo-Wooldridge, or TRW) for the missile's transporter-erector-launcher.[163]

Martin employed an extensive system for overseeing its subcontractors. At the top, the company's project manager for Pershing provided overall direction to the subcontractors and coordinated their efforts. Each major subcontract came under the supervision of a Martin procurement manager who directed a team composed of a senior engineer, a tool manager, and specialists in contracting, finance, and manufacturing. Martin also placed an engineer in the subcontractors' plants to monitor progress and ensure technical compliance.[164]

The acquisition cycle for Pershing was longer than Jupiter's, but it still bettered the 8-to-10 year average for systems of the day. The missile's first stage fired successfully at Cape Canaveral in February 1960; a successful firing of both stages occurred a year later. In December 1962, Martin delivered the first tactical system to the Army and, in June 1964, the 4th Missile Battalion, deployed in Germany, became operational.[165]

The award of the Pershing contract caused some to assert that the substantial responsibilities assumed by Martin constituted the Army's adoption of the single-prime-contractor system practiced by the Air Force. Medaris was quick to deny this, saying that the contract reflected simply "a careful appraisal of in-house and contractor resources" at the time the Army Ballistic Missile Agency had been assigned the mission.[166] Of course, as we have seen, with respect to Nike Ajax in 1945, the Army not only assigned industry the lead role, but also gave Western Electric/Bell Laboratories nearly complete freedom in the program. Yet, this was the exception, not the rule. It was not to be repeated again even when the single-prime-contractor approach was subsequently used in a few Army missile programs. Nonetheless, by the end of the 1950s, the trend was away from arsenal development toward greater responsibility for the private sector, albeit under tight Army control.

* * * * *

During the Eisenhower era, the Army scored some brilliant successes in weapons technology—orbiting the nation's first satellite, and developing, faster than either of the other services, one of the IRBM systems that had been accorded the highest national priority. Even so, some believed the Army to be in danger of falling behind in the technological race as evidenced by the increasing cycle length of its major weapons programs. To many, the explanation lay in weaknesses in the service's acquisition structure. The Army's research and development program lacked unified direction because authority on the Army staff was divided between the chief of research of development and the deputy chief of staff for logistics. Indeed, those who strongly advocated unification of those functions spent most of the decade simply securing organizational equality for research and development at service headquarters. Also, the product-oriented technical services had difficulty fielding increasingly complex systems that contained subsystems developed by two or more of them. Rather than a fundamental restructuring that might involve dissolution of the technical services, however, the Army chose to address problems within the established organizational framework because it feared that radical change might be so disruptive as to make things worse rather than better.

The decentralized and fragmented nature of Army acquisition encouraged diverse approaches to weapons development. Most major missile systems, such as Jupiter, were designed and developed within the Army's arsenal system, while a few others, such as Nike, almost entirely outside it. Although, to one degree or another, all of the major elements of the weapon system concept could be found in its programs in the decade and a half following World War II, the Army, like the Navy, did not make that acquisition strategy service-wide policy before the end of the Eisenhower administration. The existence of the arsenal system worked against assigning greater responsibility to industry, while the Army's trouble-plagued experience with "telescoped" programs during the Korean War delayed the institutionalization of concurrency until 1961.

Endnotes

1. My account of the Explorer I launch comes from Michael J. Neufeld's outstanding biography, *Von Braun: Dreamer of Space, Engineer of War*, 311-23; the biography by two of von Braun's close associates, Ernst Stuhlinger (present at the Cape during the launch) and Frederick I. Ordway III, *Wernher von Braun: Crusader for Space*, 121-40; and Medaris' memoir (with Arthur Gordon), *Countdown for Decision*, 210-26. See also Wernher von Braun, "The Redstone, Jupiter, and Juno," *Technology and Culture* 4, no. 4 (Fall 1963): 456-59; and Rebecca Robbins Raines, *Getting the Message Through: A Branch History of the U.S. Army Signal Corps*, 331. The Jupiter C (for "composite") was not the Jupiter intermediate range ballistic missile then being developed by the Army but rather a Redstone missile modified to test the Jupiter IRBM's reentry nose cone. The Jupiter designation was used to take advantage of the high priority afforded the IRBM project (Von Braun, 457; and Neufeld, *Von Braun*, 303). The cylindrical housing was rotated at high speed prior to launch and its spin rate increased in flight to provide ballistic stability and reduce the effects of thrust dispersion (Von Braun, 457).
2. Despite the Army's Explorer I triumph, many believed a military force for ground combat had no business in space, and the service came under increasing pressure to cede the high frontier to others. Consequently, in late 1959, in part to avoid losing it to the Air Force, the

Army transferred its space program, along with much of the Army Ballistic Missile Agency's facilities and people, including von Braun, to the newly established National Aeronautics and Space Administration (NASA). At the same time, NASA also acquired the Jet Propulsion Laboratory from Caltech. See Michael J. Neufeld, "The End of the Army Space Program: Interservice Rivalry and the Transfer of the von Braun Group to NASA, 1958–1959," *The Journal of Military History* 69, no. 3 (July 2005): 737-57.

3. Maxwell D. Taylor, "'Safety Lies Forward'—Technologically and Tactically," *Army* 7, no. 5 (December 1956): 21.

4. Percentages are drawn from the tables in Richard M. Leighton, *Strategy, Money, and the New Look, 1953–1956*, 113, 254, 629; and Robert J. Watson, *Into the Missile Age, 1956–1960*, 32, 100, 153, 320, 358.

5. Personnel strengths and force levels are drawn from table 6 (Actual Personnel Strengths of U.S. Armed Forces: 1952–1956), and table 8 (Actual Force Levels of U.S. Armed Forces: 1952–1956), in Robert J. Watson, *The Joint Chiefs of Staff and National Policy, 1953–1954*, 82, 84; and Byron R. Fairchild and Walter S. Poole, *The Joint Chiefs of Staff and National Policy*, *1957–1960*, 40.

6. Fairchild and Poole, *Joint Chiefs of Staff and National Policy*, *1957–1960*, 96-98.

7. See interview of General George H. Decker by Lt. Col. Dan H. Ralls, 8 December 1972, Washington, D.C., 64 [hereafter Decker interview], box 1, Papers of Gen. George H. Decker, U.S. Army Military History Institute, Carlisle Barracks, Pa. [hereafter USAMHI].

8. For detailed studies of the Army's role in post–World War II strategic air defense, see (in order of publication) Robert Lloyd Kelley, *Army Antiaircraft in Air Defense, 1946–1954*, Directorate of Historical Services, Headquarters Air Defense Command, Colorado Springs, Colo., 30 June 1954; Roy S. Barnard, *The History of ARADCOM* [Army Air Defense Command], 3 vols., Headquarters, ARADCOM, Ent Air Force Base, Colo., 1972–1974; Ernest J. Yanarella, *The Missile Defense Controversy: Strategy, Technology, and Politics, 1955–1972*; Mark L. Morgan and Mark A. Berhow, *Rings of Supersonic Steel: Air Defenses of the United States Army, 1950–1979*; and James Walker, Lewis Bernstein, and Sharon Lang, *Seize the High Ground: The Army in Space and Missile Defense*; and *History of Strategic Air and Ballistic Missile Defense, 1945–1972*, 2 vols. This previously classified 1973–1974 study was prepared by the BDM Corporation for the Joint Chiefs of Staff under a contract administered by the U.S. Army Center of Military History.

9. Leighton, *New Look*, 40, 675.

10. For analyses of the Army's response to the New Look, see A. J. Bacevich, *The Pentomic Era: The U.S. Army Between Korea and Vietnam*, 19-48; Bacevich, "The Paradox of Professionalism: Eisenhower, Ridgway, and the Challenge to Civilian Control, 1953–1955," *The Journal of Military History* 61, no. 2 (April 1997): 303-33; Leighton, *New Look*, 39-41, 655, 661-64, 668-70, 675; and David Alan Carter, "Eisenhower Versus the Generals," *The Journal of Military History* 71, no. 4 (October 2007): 1169-99. After retiring from active service, Generals Ridgway and Taylor and Lt. Gen. James Gavin, the Army's chief of research and development from 1955 until his retirement in 1958, published books that contained their views on the Eisenhower administration's military policies. See Matthew B. Ridgway, as told to Harold H. Martin, *Soldier: The Memoirs of Matthew B. Ridgway*; James M. Gavin, *War and Peace in the Space Age*; and Maxwell D. Taylor, *The Uncertain Trumpet*.

11. See chap. 4 in this volume in the acquisition history series; and Robert A. Doughty, *The Evolution of US Army Tactical Doctrine, 1946–1976*, 12-14.

12. As previously noted, the 280-mm. "Atomic Annie" was the first nuclear weapons–capable system assigned to Army field units. Another traditional field artillery system, the self-propelled, 8-inch howitzer (M55) was equipped with nuclear shells and deployed during the 1950s. For the M55, see Fred W. Crismon, *U.S. Military Tracked Vehicles*, 191.

13. Comptroller of the Army, *U.S. Army Missiles Handbook*, March 1961 (declassified copy in CMH library and archives), 48, 50, 52-53. See also, News Release No. 1124-58 (Fact Sheet

on Guided Missiles and Rockets), Office of Public Information, Department of Defense, 19 November 1958, 4-7, folder Nov. 1958, Fact Sheet on Missiles and Rockets, box 78, entry 1039A (Executive Office, Historical Branch, Records Relating to the Army Guided Missile Program, 1940–1962), RG 156. Historians of acquisition are indebted to the staff historians, particularly the extraordinarily productive Mary T. Cagle of the U.S. Army Ballistic Missile Agency and its successor organizations for detailed studies of the development, production, and deployment of specific missile systems. For Corporal, see James W. Bragg, *Development of the Corporal: The Embryo of the Army Missile Program*, 2 vols., Reports and Control Branch, Control Office, Army Ballistic Missile Agency, Army Ordnance Missile Command, Redstone Arsenal, Ala., April 1961; for Honest John, see Mary T. Cagle, *History of the Basic (M31) Honest John Rocket System, 1950–1964*, Historical Division, Administrative Office, U.S. Army Missile Command, Redstone Arsenal, Ala., 7 April 1964; for Redstone, see John W. Bullard, *History of the Redstone Missile System*, Historical Division, Administrative Office, U.S. Army Missile Command, Redstone Arsenal, Ala., 15 October 1965; for Jupiter, see James M. Grimwood and Frances Strowd, *History of the Jupiter Missile System*, History and Reports Control Branch, Management Services Office, U.S. Army Ordnance Missile Command, Redstone Arsenal, Ala. 27 July 1962; and for Lacrosse, see Mary T. Cagle, *History of the Lacrosse Guided Missile System, 1947–1962*, Historical Division, Administrative Office, U.S. Army Ordnance Missile Command, Redstone Arsenal, Ala., 10 September 1962.

14. *Missiles Handbook*, 48, 51, 53-54, 56. For the Improved Honest John, see Mary T. Cagle and Elva W. McLin, *History of the Improved (M50) Honest John Rocket System, 1954–1965*, Historical Division, Administrative Office, U.S. Army Missile Command, Redstone Arsenal, Ala., 23 August 1965; for Davy Crockett, see Leonard C. Weston, *Project Management of the Davy Crockett Weapons System, 1958–1962*, Historical Branch, Headquarters, U.S. Army Weapons Command, Rock Island Arsenal, Ill., 26 October 1964; for Sergeant, see Mary T. Cagle, *History of the Sergeant Weapon System*, Historical Division, U.S. Army Missile Command, Redstone Arsenal, Ala., 28 January 1971; and for Pershing, see Elizabeth C. Jolliff, *History of the Pershing Weapon System*, Historical Division, U.S. Army Missile Command, Redstone Arsenal, Ala., 20 May 1974.

15. In 1954, the Army deployed 48 antiaircraft (AA) artillery battalions and 19 antiaircraft (AA) missile battalions; in 1957, 26 AA artillery battalions and 58 AA missile battalions; in 1960, 56 AA missile battalions, but no AA artillery battalions. See table 13 (Growth of Continental Defense Forces), in Kenneth W. Condit, *The Joint Chiefs of Staff and National Policy, 1955–1956*, 269; and table 5 (Continental Defense Forces, 1956–1960), in Watson, *Into the Missile Age*, 404.

16. *Missiles Handbook*, 39, 41; and "Fact Sheet on Guided Missiles and Rockets," 4-5. There are two excellent studies each of Nike Ajax and Nike Hercules. From the perspective of analysis of acquisition, the best work is the five-part case study, "The Development of the Nike Guided Missile Family" (Part I, Introduction; Part II, Nike Ajax; Part III, Nike Hercules; Part IV, Nike Zeus; and Part V, Organizational and Incentive Aspects of Nike Programs), prepared in 1959 for the Weapons Acquisition Research Project, Graduate School of Business Administration, Harvard University. (A copy is in the Harvard Business School archives.) Mary Cagle is the author of the other two. For Nike Ajax, see her *Development, Production, and Deployment of the Nike Ajax Guided Missile System, 1945–1959*, Army Rocket and Guided Missile Agency, U.S. Army Ordnance Missile Command, Redstone Arsenal, Ala., 30 June 1959. Her *History of the Nike Hercules Weapon System*, Historical Division, U.S. Army Missile Command, Redstone Arsenal, Ala., 19 April 1973, remains classified in part, but the declassified portions (most of the study) are available at http://www.ed-thelen.org on the internet.

17. John C. Lonnquest and David F. Winkler, *To Defend and Deter: The Legacy of the United States Cold War Missile Program*, 165, 177.

18. *Missiles Handbook*, 42; "Fact Sheet on Guided Missiles and Rockets," 6; and R. P. Hunnicutt, *A History of American Fighting and Support Vehicles*, 194-95.

19. Excellent analyses that place Army–Air Force rivalry over guided missiles in the context of the evolution of the U.S. missile and space program from 1945 to 1960 are Watson, *Into the Missile* Age, 157-201, 361-443; and Lonnquest and Winkler, *Defend and Deter*, 20-21, 25-27, 47-64.
20. "Brief on Guided Missiles," 3, encl. to memo, Secretary of the Army Frank Pace, Jr., for Chief of Staff, U.S. Army, 13 January 1953, sub: Brief on Guided Missiles, folder Jepson, box 74, entry 1039A, RG 156.
21. Ibid., 5.
22. At a press conference in January 1956, the following exchange took place between General Taylor and a reporter regarding the just-announced Army IRBM program: "THE PRESS: Gen. Taylor, how far does your missile range extend when you refer to the fact that this will help the Army strike deep at the sources of the enemy's greatest ground strength? How far does that go? I mean does it go to the arsenals and to the war plants that produce the weapons? GEN. TAYLOR: It could . . . of course, there is no limit upon the type of target which it might strike. I am always thinking in terms of enemy ground forces since they are the primary target of all of our Army weapon systems." See Office of Public Information, Department of Defense, Minutes of Press Conference Held by General Maxwell D. Taylor, Chief of Staff, United States Army, 10 January 1956, Records, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO. Later in the year, the newly published Army regulation on missiles described the weapons as "a natural transition from present types of conventional artillery." See Army Regulation 525-30 (Army Missiles), 28 August 1956, 1, copy at USAMHI. In late 1957, in a statement that no doubt caught the attention of Air Force and Navy officials, Major General Medaris testified to Congress that U.S. missiles, like Soviet missiles, "as an extension of artillery should be in the hands of the ground forces. . . ." See testimony of Maj. Gen. John B. Medaris, Preparedness Investigating Subcommittee, Senate Committee on Armed Services, *Inquiry into Satellite and Missile Programs: Hearings before the Preparedness Investigating Subcommittee, Committee on Armed Services, United States Senate*, 85th Cong., 1st and 2d sess., pt. 1, 14 December 1957, 572 [hereafter Senate Preparedness Investigating Subcommittee hearings].
23. The best study of Thor-Jupiter is Michael H. Armacost, *The Politics of Weapons Innovation: The Thor-Jupiter Controversy*; for Bomarc-Nike Hercules, see Watson, *Into the Missile Age*, 421-31. Sometimes interservice rivalry showed itself in twisted ways. At the end of May 1957, a Jupiter executed the first successful IRBM firing. When the Army officer serving as the Army Ballistic Missile Agency's liaison at the Air Force's Ballistic Missile Division dropped by the office of Col. E. N. Hall, Major General Schriever's assistant for Thor, to tell him the news, the Air Force officer (previously known for abusive comments about Jupiter) replied by saying: "I think it is a tragic thing for the country." See memo, Lt. Col. Glenn Crane for Commanding General, Army Ballistic Missile Agency, 12 June 1957, sub: Comment by Col. Hall regarding Jupiter, Official Correspondence, A-M, 1957, Papers of John B. Medaris, Evans Library, Florida Institute of Technology, Melbourne, Fla. [hereafter Medaris Papers].
24. Watson, *Joint Chiefs of Staff and National Policy, 1953–1954*, 183-85.
25. Watson, *Into the Missile Age*, 164-65.
26. Ibid., 167-69, 186, 421-31.
27. Gen. Maxwell D. Taylor, address before the Army School Commandants, Pentagon, Washington, D.C., 28 February 1957, 9, box 2, entry 216 (Records of the Office of the Deputy Chief of Staff for Logistics; General Magruder's Files, 1951–1958), RG 319 [hereafter Taylor address, Army School Commandants, February 1957].
28. For the nature of the nuclear battlefield and Army tactical nuclear doctrine in the 1950s, see (in chronological order of publication) Col. G. C. Reinhardt and Lt. Col. W. R. Kintner [both former instructors at the Army Command and General Staff College], *Atomic Weapons in Land Combat*; Col. Theodore C. Mataxis and Lt. Col. Seymour L. Goldberg [both former instructors at the Army Infantry School], *Nuclear Tactics, Weapons, and Firepower in the Pentomic Division, Battle Group, and Company*, esp. 125-212; John P. Rose, *The Evolution of U.S. Army Nuclear*

Doctrine, 1945–1980; and Bacevich, *Pentomic Era*, 66-70, 108-19.
29. General Lyman D. Lemnitzer became chief of staff when Taylor retired in June 1959. When President Eisenhower selected Lemnitzer for the JCS chairmanship, Decker, then vice chief, became the Army's chief.
30. Decker interview, 65. For the pentomic division, see Taylor address, Army School Commandants, February 1957, 10-19; Bacevich, *Pentomic Era*, 104-08; Doughty, *Tactical Doctrine*, 16-19; Kalev I. Sepp, "The Pentomic Puzzle: The Influence of Personality and Nuclear Weapons on U.S. Army Organization, 1952–1958," *Army History: The Professional Bulletin of Army History* (Winter 2001): 1-13; and Henry G. Gole, *General William E. DePuy: Preparing the Army for Modern War*, 112-13, 120.
31. Hunnicutt, *American Fighting and Support Vehicles*, 78, 81-85, 427; and Gole, *DePuy*, 121-22.
32. Richard W. Stewart, ed., *American Military History*, Vol. II, *The United States Army in A Global Era, 1917–2003*, 277.
33. Maj. Gen. James M. Gavin, "Cavalry, And I Don't Mean Horses," *Combat Forces Journal* 4, no. 11 (June 1954): 22-27 (a reprint of the article that first appeared in *Harper's Magazine*, April 1954, 54-60). For Army aviation in the 1950s, see Richard P. Weinert, Jr., *A History of Army Aviation—1950–1962* (Fort Monroe, Va.: Office of the Command Historian, U.S. Army Training and Doctrine Command, 1991). Weinert provides good coverage of aviation acquisition during this period. A concise summary of doctrinal development for air assault is in Doughty, *Tactical Doctrine*, 27-29.
34. Raines, *Getting the Message Through*, 334-35, 342.
35. Taylor address, Army School Commandants, February 1957, 11-12.
36. Signal Corps Historical Division, "Documentation of Growth and Importance of Military Comms-Electronics R&D, 1950–1960," [1960], 3, and supplement to "Documentation of Growth and Importance of Military Comms-Electronics," [1960], 5: both in box 57, Signal Corps Historians' Collection, 1870–1971, USAMHI.
37. Taylor address, Army School Commandants, February 1957, 12.
38. Mark S. Watson, "New Trend in Weapons," *Ordnance* 45, no. 244 (January–February 1961): 490. In late 1958, Maj. Gen. Robert J. Wood, the deputy chief of research and development on the Army staff, remarked in a closed forum: "The XM60 tank [is] an interim vehicle—we had to come up with something because the Bureau of the Budget, in its wisdom, decided we wouldn't buy any more M48s." See Office, Chief of Research and Development, Department of the Army, Record of Research and Development Lead Time Symposium, 9–10 December 1958 [1959], 102, in OCRD Summary of Major Events and Problems, FY 1959, copy in CMH library and archives. For evolution of the Army's tank program during the Eisenhower years, see R. P. Hunnicutt, *Patton: A History of the American Main Battle Tank*, Vol. I , pt. III; and Oscar C. Decker, "The Patton Tanks: The Cold War Learning Series," in *Camp Colt to Desert Storm: The History of U.S. Armored Forces*, ed., George F. Hoffman and Donn A. Starry, 307-11.
39. Semiannual Report of the Secretary of the Army, January 1, 1957, to June 30, 1957, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1957*, 104. For FY 1958, the Army requested $566 million for research and development—$86.4 million (32.9 percent, missiles), $35.3 million (6.2 percent, aircraft), and $25.1 million (4.4 percent, combat and support vehicles). See House of Representatives, 32d Report of the Committee on Government Operations, *Research and Development (Office of the Secretary of Defense)*, 85th Cong., 2d sess., 1958, H. Rpt. 2552, 153.
40. Annual Report of the Secretary of the Army, July 1, 1960, to June 30, 1961, in Department of Defense, *Annual Report for Fiscal Year 1961*, 137.
41. "Armed Forces: Forces on the Ground," *Time* 73, no. 19 (11 May 1959): 23.
42. Subcommittee on Research Activities in the Department of Defense and Defense Related Agencies of the Committee on Business Organization of the Department of Defense, *Report*

on Research Activities in the Department of Defense and Defense Related Agencies. Prepared for the Commission on Organization of the Executive Branch of the Government, April 1955, 55 [hereafter Hoover Commission Subcommittee on Research Activities report].

43. L. Van Naisawald, "The History of Army R&D Organization and Program, Part I—Organization," U.S. Army Research and Development Organization, [1962], 63-64, 70, 72-73, copy in CMH library and archives, call no. 2-2.5 AA 1. The standard history of Army organization in the first half of the twentieth century is James E. Hewes, Jr., *From Root to McNamara: Army Organization and Administration, 1900–1963*. Hewes draws almost exclusively on Van Naisawald for the evolution of R&D organization from 1945–1960. This study relies on Van Naisawald, the more detailed account.

44. Ibid., 100. For a brief outline of the history of the Army Scientific Advisory Panel (renamed the Army Science Board in 1977), see Scott S. Haraburda, "Army Science Board—Providing a Half Century of Scientific Advice and Guidance," *Army AL&T* [Army Acquisition, Logistics and Technology], January–March 2006, 70-73.

45. Van Naisawald, "Army R&D Organization and Program," 75-82.

46. Ibid., 86. After reviewing the plan, President Eisenhower wrote Secretary Wilson in late January 1954: "Much of it is, of course, good. But I am struck by the apparent conviction of the Committee that 'overhead' should be so markedly increased. For example, it is now recommended that we have two Vice Chiefs of Staff, in addition to the presently authorized two Deputy Chiefs of Staff—and on top of this that we organize a Supply Command" [underlining in original]. Memo, D. D. E. for the Secretary of Defense, 27 January 1954, folder DDEL, 1954, box 9, Richard D. Leighton materials collected for preparation of *New Look*, deposited with the National Archives and Records Administration. The original document is from Administration File, Eisenhower Papers as President, 1953–1961 (Whitman File), Dwight D. Eisenhower Library, Abilene, Kans.

47. Van Naisawald, "Army R&D Organization and Program," 86-87; and "Secretary of the Army's Plan for Reorganization," 14 June 1954, 18, folder Fourth Service in War, box 15, entry 366C (Office of the Assistant Secretary of Defense [Comptroller]; Office of the Director for Plans and Systems; Hoover Commission Files), RG 330. At this time, the Army was authorized only two assistant secretaries, the assistant secretary for financial management and the assistant secretary for manpower and reserve affairs. Legislation would be required to increase the total to four, the number that Stevens desired, including an assistant secretary for logistics and research and development and an assistant secretary for civil-military affairs.

48. Quoted in Van Naisawald, "Army R&D Organization and Program," 90.

49. Quoted ibid., 87-88.

50. Ibid., 95a, 95b, 95d. On 17 June, Killian testified before the Riehlman subcommittee that "I think in general it is very unfortunate and a great handicap if procurement is mixed up with research, and there has been a tendency for the man who is responsible ultimately for procurement to be also responsible for research. . . . research and development should never be subordinated by procurement." See testimony of James R. Killian, Jr., Subcommittee, House Committee on Government Operations, *Organization and Administration of the Military Research and Development Programs: Hearings before a Subcommittee, Committee on Government Operations, House of Representatives*, 83d Cong., 2d sess., 17 June 1954, 434, 436. See also House of Representatives Committee on Government Operations, 24th Intermediate Report, *Organization and Administration of the Military Research and Development Programs*, 83d Cong., 2d sess., 1954, H. Rpt. 2618, 12-13.

51. Van Naisawald, "Army R&D Organization and Program," 103.

52. Ibid., 104, 104c. As assistant chief of staff for logistics (G–4), Lieutenant General Palmer had opposed the Davies committee proposal for a Supply Command, maintaining that the Army staff could not be divorced from aspects of supply operations and that, if anything, G–4 should have greater control over the technical services, including personnel and organization. See Hewes, *Root to McNamara*, 228-32. On the eve of the secretary's decision rescinding the

transfer of research and development functions to the deputy chief of staff for logistics, General Palmer spoke at the Industrial College of the Armed Forces. Following his prepared remarks, Palmer was asked: "We have a Deputy Chief of Staff for Plans and Research; now we have one for Logistics, both with research and development responsibilities at the same level on the [organization] chart. Do we consider the two a team or will we turn R&D all over to Logistics?" Palmer replied: "I am not in an empire building mood but I believe the whole R&D staff ought to be put into one place. I am perfectly willing to have it under either head, where judged by other people it will work best. There has been some struggle, not entirely resolved, but I am not a party to it. There are differences of opinion from outside. As you all know, that is the great difficulty in getting anything done in Washington—having been given responsibility to discharge, you can't discharge because outsiders think it should be run on an entirely different basis and keep the argument open." See Lt. Gen. W. B. Palmer, "The Deputy Chief of Staff for Logistics," address to the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., 13 December 1954, 11, NDU Library.

53. McKinsey and Company, "Evaluation of Organizational Responsibilities, Department of the Army," Vol. I, 11 March 1955, 1-4,1-5, 2-12, 2-13, folder McKinsey Report, box 16, entry 366C, RG 330; and Hoover Commission Subcommittee on Research Activities report, 53, 56.

54. The four assistant secretary of the Army positions were civil-military affairs, financial management, logistics and research and development, and manpower and reserve affairs.

55. Office of the Chief of Research and Development, "'Path of Progress': U.S. Army R&D Organizational Changes, 1924–1960," 21 September 1960, 10-11, folder 201-45, R&D Div Orgn, 1951–54, box 3, entry 40 (Records of the Office of the Chief of Research and Development; Records Relating to the Organization of Army Research and Development Activities, 1943–1960), RG 319; and Van Naisawald, "Army R&D Organization and Program," 105-09.

56. Van Naisawald, "Army R&D Organization and Program," 110-11.

57. The secretary of the Army's 1954 reorganization plan provided for the transfer of the six continental armies and the Military District of Washington from the direct supervision of the chief of staff to a new organization, the Continental Army Command (CONARC). Its commander would still report to the chief of staff, but the latter's span of control would be reduced as well as the involvement of the Army staff in matters that would now be handled by the CONARC staff. Formally established on 1 February 1955, CONARC also assumed the functions that had been performed by the Army Field Forces. See "Secretary of the Army's Plan for Reorganization," 14 June 1954, 15; and Hewes, *Root to McNamara*, 266-67.

58. Army Regulation 705-5 (Research and Development of Materiel), 28 December 1955, 4-5, copy at USAMHI. Service tests followed the engineering tests performed by the technical service that had developed the item. The test boards were the Air Defense Board at Ft. Bliss, Tex.; the Airborne and Electronics Board at Ft. Bragg, N.C.; the Arctic Test Board at Ft. Greely, Alaska; the Armor Board at Ft. Knox, Ky.; the Artillery Board at Ft. Sill, Ok.; the Aviation Board at Ft. Rucker, Ala.; and the Infantry Board at Ft. Benning, Ga.

59. Memo, Maj. Gen. Andrew P. O'Meara, Deputy Chief of Research and Development, for Lieutenant General Gavin, 12 July 1957, 1, sub: Organization for Research and Development, folder 201-45 Orgn—Future Orgn of OCRD, 1957, box 3, entry 40, RG 319.

60. Tab E (USCONARC Boards and User Tests) to OCRD Staff Study, "The Organization of Office, Chief of Research and Development," [September 1957], folder 201-45 Orgn—Staff Study (Seneff Report), 1957, box 5, entry 40, RG 319.

61. "Director Morse Promoted to Assistant Secretary," *Army Research and Development* 2, no. 3 (March 1961): 6.

62. Van Naisawald, "Army R&D Organization and Program," 111-14. The Department of Defense Reorganization Act of 1958 had limited the number of assistant secretaries in each of the services to three, forcing the Army to eliminate one of its four. Requesting an additional assistant secretary post would not have been timely. Additionally, Lieutenant General Trudeau

had indicated that he did not believe designation as a deputy chief of staff was necessary for his post.

63. Ibid., 114-16.

64. Ibid., 116-31.

65. Ibid., 132-36.

66. Memorandum for record, Lt. Col. Louis F. Felder, Assistant Secretary of the General Staff, 9 August 1960, sub: Army Organization for Research and Development, folder Conferences, Technical Service Chiefs Meetings, 1960, box 2, entry 1004 (Records of the Office of the Chief of Ordnance; Office Files of Gen. John H. Hinrichs, 1958–1962), RG 156.

67. Memorandum for record, Lt. Gen. J. H. Hinrichs, Chief of Ordnance, 6 September 1960, sub: Chief of Research and Development's Luncheon for Technical Service Chiefs, 6 September 1960, ibid.

68. Raymond J. Snodgrass, *The Concept of Project Management*, Historical Office, U.S. Army Materiel Command, June 1964, 21-25; and René J Francillon, *Grumman Aircraft since 1929*, 414-16.

69. Memorandum for record, Lt. Gen. J. H. Hinrichs, Chief of Ordnance, 27 October 1960, sub: Technical Service Chiefs Meeting, 26 October 1960, folder Conferences, Technical Service Chiefs Meetings, 1960, box 2, entry 1004, RG 156.

70. See app. B (Department of Army Actions to Reduce Time from Concept to Inventory of Materiel Used by the Army in the Field) to encl. (*Maximum Improvement in Air Weapon Systems in Minimum Time: Summary of Actions Taken to Reduce the Time Required for Research, Development, Procurement, and Production of Manned Aircraft Weapon Systems*, 8 February 1957) to ltr, Reuben B. Robertson, Jr., Deputy Secretary of Defense, to Secretary of Defense, 9 February 1957, folder Research and Development (General), 1956–1959, box 832, Subject Files (Research and Development, 1953–1960), OSD/HO; and Materiel Requirements Review Committee, Lead Time Study, August 1961, 4: 2, folder Background Material, MRRC, box 25, entry 21 (Office of the Secretary of the Army; Records of the Hoelscher Committee, Study Groups, 1961–1962), RG 335.

71. Ltr, Frederick L. Hovde, Chairman, Army Scientific Advisory Panel, to Secretary of the Army Wilber M. Brucker, 30 October 1957, tab A to memo, Col. George C. Fogle, Chief, Programs Branch, Office, Chief of Research and Development, for Chief, Financial Management Branch and Chief, Review and Analysis Branch, 24 July 1958, sub: Dr. Hovde's Letter to Secretary Brucker, dated 30 October 1957, folder 250/11 ASAP Subpanel on Research Org & Planning, 1958, box 1, entry 36 (Records of the Office of the Chief of Research and Development; Security Classified General Correspondence, 1958–1959), RG 319.

72. Ltr, Daniel E. Noble, Chairman, Subpanel on Management of R&D, Army Scientific Advisory Panel, to Richard S. Morse, President, National Research Corporation, 20 September 1958, ibid; and Office, Chief of Research and Development, "Summary of Major Events and Problems, Fiscal Year 1959," 26-27 [hereafter OCRD Summary of Major Events and Problems], CMH library and archives. Noble was executive vice president of Motorola, Inc.

73. Ltr, Richard S. Morse, Chairman, Army Scientific Advisory Panel, to Secretary of the Army Wilber M. Brucker with encl. (Recommendations to Reduce Army R&D Time Cycles), 31 October 1958, tab A to staff summary sheet, Maj. Gen. R. J. Wood, Deputy Chief of Research and Development, n.d., sub: Recommendations of the Army Scientific Advisory Panel, folder 201-45 Orgn & Functions, OCRD, 1958–60, box 2, entry 40, RG 319 [underlining in original].

74. Senate Preparedness Investigating Subcommittee hearings, pt. 2, 10 January 1958, 1713-14.

75. Office, Chief of Research and Development, Department of the Army, "Record of Research and Development Lead Time Symposium, 9–10 December 1958," [1959], 209-12 [hereafter Lead Time Symposium proceedings], OCRD Summary of Major Events and Problems, FY 1959.

76. Lt. Gen. Arthur G. Trudeau, Office, Chief of Research and Development, "Welcome

Address," Lead Time Symposium proceedings, 7-11 (quotations, 7 and 11). Trudeau provided a working definition of lead time for the conferees: "the time from the initiation or acceptance of a concept to the time the end item incorporating the concept is available in quantity to the user of the item." (7) A September 1958 study of lead time and testing (using a definition similar to Trudeau's) by the Operations Research Office concluded that ten years was a "fair generalization" for Army systems. At the same time, the study found a broad range of elapsed times. For example, the AN/TPQ–5 radar net took about 15 years; an Entrapped Air Life Preserver 3 to 5 years; and a 16-foot Plastic Assault Boat of simple design, 10 to 12 years. But the Little John Rocket, equipped with a nuclear warhead and with some 70 missiles fired, required only 20 months. See W. Scott Payne et al., *Engineering and User Tests in Relation to Research and Development Lead Time*, Operations Research Office, The Johns Hopkins University, September 1958, A15.
77. Lead Time Symposium proceedings, 9-10.
78. Lt. Col. J. T. O'Hea, Office, Chief of Ordnance, "The Project Manager Concept," 116, ibid.
79. Col. D. M. Simpson, Office, Deputy Chief of Staff, Logistics, "Transition from Development to Production," 99, ibid.
80. Dr. W. H. Martin, Office, Secretary of the Army, "The R&D Cycle in Major Industry," 53 (quotation), 54-59, ibid.
81. Dr. W. S. Payne, Operations Research Office, "Summary of ORO Time Lag Studies," 72, and Col. G. C. Essman, Office of the Chief Chemical Officer, 105-08: both ibid. For its development projects, the Chemical Corps designated a "project engineer" and "associate project engineers" for each phase of the acquisition cycle. Thus an officer from research and development would be the "project engineer" during that phase of acquisition and be assisted by "associate project engineers" representing the other phases (i.e., engineering, production, procurement, supply, training, doctrinal application). Essman pointed out, however, that the project engineers acted only as staff members—they had no independent decision-making power unless granted it by their functional organization chief. And, even in that case, they had no authority that cut across other Chemical Corps functional elements. See also Chemical Corps Regulation 600-6 (Project and Associate Project Engineers), 14 April 1958, folder Lead Time, Vols. I and II, box 6, entry 93 (Records of the Office of the Deputy Chief of Staff for Military Operations; Records of the Materiel Requirements Review Committee, 1959–1965), RG 319.
82. Simpson, "Transition from Development to Production," Lead Time Symposium proceedings, 100.
83. See chap. 4 in this volume; and Army Regulation, 705-5 (Research and Development of Materiel), 10 September 1958, 20-21, copy at USAMHI. Technical characteristics were simply restatements of a system's military characteristics in technical terms. A system being developed by a contractor rather than in one of the Army's arsenals would undergo tests by the contractor prior to technical service engineering tests. Following CONARC's service tests and, if necessary, a system might be subject to testing by operational units, so called "troop" tests.
84. O'Hea, "Project Manager Concept," Lead Time Symposium proceedings, 119.
85. Col. E. G. Shinkle, "The R&D Cycle as Viewed by USCONARC," 149, ibid.
86. Payne, "Summary of ORO Lag Time Studies," ibid., 65-69 (quotation, 66). The Signal Corps provided support for the analysis of the Operations Research Office. In the "Expedited Service Test Program" that it designed together with the Continental Army Command, decreasing test cycle time by 50 percent resulted in a reduction of only 5 percent of the system's total development time. See Col. J. W. Johnston, "The Expedited Service Test Program Currently in Operation by the Signal Corps," 128, ibid.
87. Memo, Col. Robert C. Cassibry, Chief, Organizational Analysis Division, Office of the Comptroller, 5 January 1961, VCS [vice chief of staff] Action Regarding Reduction in Lead Time; and encl. (Reduction of Lead Time), 2, to memo, Lt. Gen. David W. Traub, Comptroller of the Army, for Chief of Staff, 9 January 1961, sub: Reduction of Lead Time: both in folder MRRC Lead Time Study, box 1, entry 239 (Records of the Comptroller of the Army, Staff

Study Reports and Related Correspondence, 1956–1965), RG 319.
88. Memo, Maj. Gen. Robert J. Wood, Deputy Chief of Research and Development, for Chairman, Ad Hoc Group on Lead Time, 30 January 1959, sub: Organization and Functions, tab A to Report of Ad Hoc Committee: Reduction of Research and Development Lead Time, 6 March 1959 [hereafter Ad Hoc Committee report], in OCRD Summary of Major Events and Problems, FY 1959.
89. Cassibry memo, 5 January 1961; and Bill Borklund, "Time . . . The Resource We Mismanage Most," *Armed Forces Management* 5, no. 8 (May 1959): 18.
90. Ad Hoc Committee report, 2-9; OCRD Summary of Major Events and Problems, FY 1959, 28; and Cassibry memo, 5 January 1961.
91. Draft Army Regulation 705-5 (Research and Development of Materiel), 26, in OCRD Summary of Major Events and Problems, FY 1959; and Army Regulation 705-5 (Research and Development of Materiel), 10 September 1958, 20-21. The chairman of the ad hoc committee was a lieutenant colonel from the Office of the Chief of Research and Development, but the senior officer on the committee was Colonel Shinkle from the Continental Army Command who had expressed that command's preference for sequential testing and opposition to consolidated testing at the Lead Time Symposium.
92. Comment of subpanel members prepared for subpanel report, 17 April 1959, folder 250/11 ASAP, Subpanel on Research Org and Planning, 1959, box 1, entry 36, RG 319.
93. Army Regulation 705-5 (Research and Development of Materiel), 21 December 1959, 14, copy at USAMHI.
94. Memorandum for record, Maj. Gen. H. F. Bigelow, Deputy Chief of Ordnance, 4 January 1961, sub: DCSLOG Technical Service Chiefs' Luncheon, 4 January 1961, folder Conferences, Technical Service Chiefs Meetings, 1961, box 2, entry 1004, RG 156.
95. Ibid.; memo, Brig. Gen. J. L. Throckmorton, Secretary of the General Staff, for Deputy Chiefs of Staff, Chief of Research and Development, Comptroller of the Army, Assistant Chief of Staff, Intelligence, 24 January 1961, sub: Reduction of Lead Time; and memo, Brig. Gen. John T. Snodgrass, Alternate Representative Chairman, Military Requirements Review Committee [for Maj. Gen. H. H. Fischer, chairman, Military Requirements Review Committee] for [addressees in Throckmorton memo], 24 February 1961, sub: Review of Reduction of Lead Time: both in folder MRRC Lead Time Study, box 1, entry 239, RG 319.
96. Memorandum for record, Assistant Secretary of the General Staff, 29 February 1960, sub: Meeting of Materiel Requirements Review Committee, folder Case Hist.—AN/VRC–12 (Vol. 1), 19 January 1960, box 2, entry 93, RG 319.
97. Materiel Requirements Review Committee, Lead Time Study, August 1961, 3, folder Background Material, MRRC, box 25, entry 21, RG 335 [hereafter MRRC study]. Total lead time was computed from the date establishing a requirement for an item or the date it was first funded, whichever came first, to the date the item was available to operational units.
98. Ibid., 17.
99. Ibid., encl. 4: 21.
100. Ibid., encl. 4: 22.
101. Ibid., 3, 4 (quotation), encl. 1: 3 [italics added].
102. Ibid., encl. 4: 22.
103. Ibid., 36-37.
104. Ibid., 8-13.
105. Memorandum for record, Lt. Col. D. P. McAuliffe, Assistant Secretary of the General Staff, 28 August 1961, sub: Reduction of Lead Time, folder MRRC Lead Time Study, box 1, entry 239, RG 319.
106. Chas Wendel, "Army Moves to Cut Down Lead Time," *Electronic News* 6 (20 November 1961): 45.
107. MRRC study, 29.
108. Army Regulation 11-25 (Reduction of Lead Time), 27 September 1961, 2, 6, copy at

USAMHI.
109. See memo, Col. Henry A. Miley, Jr., for Chief, ORDIT, 23 January 1959, sub: Information on Pre-Production Testing; memo, Maj. Gen. J. H. Hinrichs, Chief of Ordnance, for Chief, ORDIX , Chief, ORDTX, 29 January 1959, sub: Early Production Try-Outs; and memo, Brig. Gen. F. J. Morrow, Chief, Industrial Division, Ordnance Corps, for Chief of Ordnance, 18 February 1959, sub: Early Production Try-Outs: all in folder Conferences, Technical Service Chiefs Meetings, Jan. 1959–Jun. 1959, box 2, entry 1004, RG 156. Colonel Miley, who had been tasked to estimate cost factors involved in the proposal for a slow rate of initial production, reported that "We [Ordnance Corps] have never followed the procedure visualized by the change, and hence there is no good data available."
110. Memo, Maj. Gen. J. H. Hinrichs, Chief of Ordnance, for Dr. W. H. Martin, Director of Research and Development, 7 January 1959, sub: The Research and Development Cycle, folder Reading File, Jan.–June 1959, box 3, entry 1004, RG 156 [underlining in original].
111. "Review of Reduction of Lead Time," QMC [Quartermaster Corps] briefing to Materiel Requirements Review Committee, [1961], 19, folder Lead Time Vols. I and II, box 6, entry 93, RG 319.
112. "Lead Time Presentation to Army Scientific Advisory Panel," 14 March 1968, 18, folder Lead Time Study Briefing, box 7, entry 93, RG 319.
113. "Engineer Memoirs: Lieutenant General Arthur G. Trudeau, USA, Retired," 298, transcript of an interview of Lt. Gen. Arthur G. Trudeau by Col. Calvin J. Landau while the latter was a student at the U.S. Army War College in 1971. Prepared for publication by Dr. Paul K. Walker, Historical Division, Office of the Chief of Engineers and printed by arrangement with CMH, February 1986. A copy of the unedited interview transcript is at USAMHI.
114. Maj. Gen. H. N. Toftoy, "Army Missile Development," *Army Information Digest* 11, no. 12 (December 1956): 24-25, 33-34.
115. Memorandum for record, Maj. Gen. E. L. Cummings, Chief of Ordnance, 27 October 1955, folder Special Army Ballistic Missile Agency, box 95, entry 1039A, RG 156 [hereafter Cummings memorandum for record]. In addition to Cummings' memorandum, another first-hand account is by Major General Medaris who attended some of the meetings. See Medaris, *Countdown for Decision*, 68-73.
116. Memo (with organization chart), Gen. Maxwell D. Taylor, Chief of Staff, for Secretary of the Army, 26 October 1955, sub: Organization for the Prosecution of the 1500-Mile Missile Program, folder Special Army Ballistic Missile Agency, box 95, entry 1039A, RG 156; and memo, Brig. Gen. W. C. Westmoreland, Secretary of the General Staff, for Deputy Chief of Staff for Logistics, Comptroller of the Army, Chief of Research and Development, The Inspector General, Assistant Chiefs of Staff, Heads of Special Staff Agencies, Heads of Technical Services, Chief of Finance, 26 October 1955, sub: Organization for the Prosecution of the 1500-Mile Missile Program, folder Organization of ABMA, 1956, box Army Ballistic Missile Agency, Medaris Papers. According to Cummings, Gavin, who had been supported by Palmer, withdrew his objections when he saw the organization chart showing that the commander of the Army Ballistic Missile Agency would report through both his office and that of the deputy chief of staff for logistics.
117. Cummings memorandum for record.
118. Grimwood and Strowd, *Jupiter Missile System*, 14-15.
119. News Release No. 264-58 (Fact Sheet, U.S. Army Ordnance Missile Command), Office of Public Information, Department of Defense, 20 March 1958, folder 31 Mar. 58-Estab. of Army Ordnance Missile Command, box 92, entry 1039A, RG 156; "Information on Army Missile Programs Required by the Military Operations (Holifield) Subcommittee of the Committee on Government Operations, House of Representatives," [1960], box 22, entry 1039A, RG 156; and Elizabeth C. Jolliff, *History of the United States Army Missile Command, 1962–1967*, Historical Division, U.S. Army Missile Command, 20 July 1979, 4.
120. Colonel Furphy, Chief, Management Operations Branch, Research and Development

Division, Office, Chief of Ordnance, "Organization for Missile Production," presentation to Management Subpanel, Army Scientific Advisory Panel, 25 February 1959, folder 250/11ASAP, Subpanel on Research Org. and Planning, 1959, box 1, entry 36, RG 319. With the Army Rocket and Guided Missile Agency assuming the operational portions of the Redstone Arsenal's mission, the latter was left with installation support and depot functions.

121. Army Ordnance Missile Command, *Mission, Scope, Management and Organization of U.S. AOMC*, [mid-1960], 20, folder Background Material, Ordnance, box 25, entry 21, RG 335. Army Ballistic Missile Agency programs included Redstone, Jupiter, Pershing, Sergeant, Corporal, Honest John, Little John, Missile "B" (later designated Lance, a mobile field artillery tactical missile to replace Honest John and Sergeant).

122. Ibid., 21. Army Rocket and Guided Missile Agency programs included Nike Zeus, an antiballistic missile for defense against ICBMs; FABMDS (Field Army Ballistic Missile Defense System), a theater air defense system; Nike Hercules; Nike Ajax; Hawk; Mauler, a self-propelled antiaircraft missile system for defense against low-flying aircraft and short-range ballistic missiles; Redeye, a shoulder-fired missile for defense against low-flying aircraft; Lacrosse; and Shillelagh, a cannon-launched antitank missile.

123. For the decline of the arsenal system in the decade and a half following World War II, see Aaron L. Friedberg, *In the Shadow of the Garrison State: America's Anti-Statism and Its Cold War Grand Strategy*, 269-72.

124. Maj. Gen. John B. Medaris, address to St. Louis Post, American Ordnance Association, 9 April 1959, 15-19; Medaris address, "Missile Procurement," unidentified audience, Detroit, Mich., 16 June 1959, 4; Medaris address to 13th National Conference on Research Administration, 28–30 September 1959, 5 (quotation): all in box 28, entry 1039A, RG 156; Maj. Gen. J. B. Medaris, "The Arsenal Philosophy," *Ordnance* 44, no. 235 (July–August 1959): 52; and Medaris, *Countdown for Decision,* 99.

125. Joseph C. Moquin, "Creating the IRBM," *Ordnance* 42, no. 224 (September–October 1957): 252; and House Committee on Government Operations Eleventh Report, *Organization and Management of Missile Programs*, 86th Cong., 1st sess., 2 September 1959, Committee Print 1121, 51 [hereafter Eleventh report].

126. Neufeld, *Von Braun*, 301-02.

127. Charles H. Donnelly, *The United States Guided Missile Program*, report prepared for the Preparedness Investigating Subcommittee of the Committee on Armed Services, United States Senate, 86th Cong., 1st sess., January 1959, Committee Print, 68.

128. Lonnquest and Winkler, *Defend and Deter*, 259, 269.

129. Eleventh report, 50.

130. Statement by Lt. Gen. John H. Hinrichs on Missile Systems Contracting before the Permanent Investigation Subcommittee, Government Operations Committee, United States Senate, 87th Cong., 2d sess., [1962], 10 [hereafter Hinrichs statement]; and John B. Medaris, "The Anatomy of Program Management," in *Science, Technology, and Management*, ed., Fremont E. Kast and James E. Rosenzweig, 113. Ironically, the Army Ballistic Missile Agency ended up doing some production. In late 1957, the Department of Defense, although directing that both Jupiter and Thor enter production, had not yet determined the numbers of missiles and quantities of ground support equipment to be manufactured, established a production schedule, or provided any funding. Pending these decisions ABMA, under pressure to get Jupiter ready for deployment, was forced to manufacture some missiles in Huntsville. See Medaris, *Countdown for Decision*, 182-84.

131. Quoted in Paul H. Satterfield and David S. Akens, *Government-Contractor Relationships at ABMA*, Operating Services Office, Army Ballistic Missile Agency, 1 July 1959, 59-60, box 5, entry 1021 (Records of the Office of the Chief of Ordnance; Executive Office; Historical Branch; Military Historians Files, 1947–1961), RG 156.

132. Medaris, "Program Management," 115.

133. Satterfield and Akens, *Government-Contractor Relationships*, app. 19 (Contractors

Structure: Missile System, Jupiter).
134. Hinrichs statement, 11; and Medaris, "Program Management," 115.
135. Evert Clark, "Speed Marks Jupiter Development," *Aviation Week* 70, no. 15 (13 April 1959): 57.
136. T. F. Morrow [group vice president, Chrysler Corporation], "Chrysler's Redstone, Jupiter, and Explorer Programs," *Science, Technology, and Management*, 131-32.
137. Medaris address, "Missile Procurement," 16 June 1959, 8.
138. Ibid., 8-9.
139. Daily Journal, 2 March 1956, box Daily Journal, 1956, Medaris Papers.
140. Maj. Gen. John B. Medaris, "The Revolution in Weapons Development," *Army* 8, no 2 (September 1957): 35-36; and Maj. Gen. John B. Medaris, address to 13th National Conference on Research Administration, 28–30 September 1959, 10-11. Medaris considered that his role as weapon system manager extended beyond development and production to the system's employment. In April 1956 (before he knew the Air Force and not the Army would operate Jupiter), he wrote General W. G. Wyman, commander of the Continental Army Command: "My feeling is that a 'weapon system' is much more than the hardware that goes into the weapon and its associated equipment, and that in dealing with these advanced weapons of such tremendous firepower capabilities, the approach to the weapon system must include realistic concepts, doctrine, organization (including all organizational elements dealing with the missile system), procedures, logistical support, and tactical employment." Development of employment concepts and doctrine for weapon systems was Wyman's job, but Medaris told the CONARC commander that he had established a "Military Applications Board" at the Army Ballistic Missile Agency to consider those matters with respect to long-range missiles. "I must say," he told Wyman, "the recommendations which they have brought to me so far are at considerable variance with the more traditional concept and doctrine I have heard from other sources, but in my opinion fully responsive to the potential of these new weapons." How Wyman felt about this intrusion into his sphere of responsibility is not known. Ltr, Maj. Gen. John B. Medaris to Gen. W. G. Wyman, Commanding General, CONARC, 20 April 1956, Official Miscellaneous Correspondence, 1956, Medaris Papers; and Medaris, *Countdown for Decision*, 102.
141. Medaris, "Revolution in Weapons Development," 36; Medaris testimony, Senate Preparedness Investigating Subcommittee hearings, pt. 2, 10 January 1958, 1712; Maj. Patrick W. Powers [Office of the Chief of Research and Development], "No Time for Sale," *Army* 9, no. 8 (March 1959): 37; Clark, "Speed Marks Jupiter Development," 54-55, 57; Medaris, *Countdown for Decision*, 133, 176-77, 190; and Grimwood and Strowd, *Jupiter Missile System*, 73-76, 87-89.
142. Moquin, "Creating the IRBM," 249; and Grimwood and Strowd, *Jupiter Missile System*, 22.
143. "The Extension of Special Organizational Patterns and Management Techniques to Additional Weapon Systems," January 1962, 2:10 (Study prepared for the Assistant Secretary of Defense, Installations and Logistics by United Research Incorporated, Cambridge, Mass.); and Snodgrass, *The Concept of Project Management*, 45, 53, 56-60.
144. Grimwood and Strowd, *Jupiter Missile System*, 103, app. 1:11.
145. Memorandum for record, Lt. Gen. J. H. Hinrichs, Chief of Ordnance, 10 March 1960, sub: Army Ballistic Missile Committee Meeting, 9 March 1960, folder Conferences, Technical Service Chiefs Meetings, 1960, box 2, entry 1004, RG 156.
146. See pt. II, "The Development of the Nike Ajax Guided Missile System," [1959], 56; and pt. V, "Organizational and Incentive Aspects," November 1959, 1, of "The Development of the Nike Guided Missile Family," prepared for the Weapons Acquisition Research Project, Graduate School of Business Administration, Harvard University [hereafter Nike Guided Missile Family case studies]. Copy obtained from Dr. Frederic M. Scherer.
147. Nike Guided Missile Family case studies, pt. II, 31-46; and pt. V, 31, 33.
148. Ibid., pt. II, 56; and pt. V, 13-14, 31.

149. Bell Telephone Laboratories, Inc., and Douglas Aircraft Company, Inc., "Project Nike—History of Development," 1 April 1954, 3 (Report of the History of the Development of Nike from Its Conception in 1945 to the Official System Tests in 1952, prepared for the Ordnance Corps.); W. H. C. Higgins, "Project Nike," *Ordnance* 39, no. 206 (September–October 1954): 231; Robert F. S. Homann, "Weapon System Concepts and Their Pattern in Procurement," in *Research and Development Procurement Law*, ed., Albert C. Lazure and Andrew P. Murphy, Jr., 408; Cagle, *Development, Production, and Deployment of the Nike Ajax*, 8-9; and Nike Guided Missile Family case studies, pt. V, 11.
150. Cagle, *Nike Ajax*, 8; Nike Guided Missile Family case studies, pt. II, 54-55; and Lonnquest and Winkler, *Defend and Deter*, 165.
151. News Release No. 1158-54 (Address by Maj. Gen. Leslie E. Simon, Assistant Chief of Ordnance for Research and Development, before the American Ordnance Association, 1 December 1954, New York City), Office of Public Information, Department of Defense, 1 December 1954, 3, folder R&D Speeches, 1953–1955, box 838, Subject Files (Research and Development, 1953–1960), OSD/HO [hereafter Simon address, 1 December 1954].
152. Cagle, *Nike Ajax*, 8-9.
153. Lonnquest and Winkler, *Defend and Deter*, 170-71.
154. Simon address, 1 December 1954, 1; and Donnelly, *Guided Missile Program*, 63.
155. Interview of Frederic M. Scherer by Defense Acquisition History Project team, 7 June 2006, U.S. Army Center of Military History, Fort Lesley J. McNair, Washington, D.C., 29-30.
156. Eleventh report, 50-51.
157. Army Ballistic Missile Agency policy statement, "Technical Operations, Use of Outside Agencies," [late 1957], folder ABMA Policy Discussions, 1957–1958, file Army Ballistic Missile Agency, Medaris Papers.
158. Jolliff, *Pershing Weapon System*, 1-12.
159. "Verbatim Remarks by General Medaris Made During Staff Meeting, 16 January 1958, Regarding Development for New Missile System," folder ABMA Policy Discussions, 1957–1958, file Army Ballistic Missile Agency, Medaris Papers.
160. Satterfield and Akens, *Government-Contractor Relationships*, 25, 80; Eleventh report, 51; Medaris, *Countdown for Decision*, 232; Medaris, "Program Management," 115-16 (quotation) [italics in original]; and Jolliff, *Pershing Weapon System*, 17-18, 23.
161. Evert Clark, "Pershing to Test Industry's Missile Role," *Aviation Week* 70, no. 12 (23 March 1959): 52-53; Satterfield and Akens, *Government-Contractor Relationships*, 77; and Jolliff, *Pershing Weapon System*, 21-22. The other finalists were Chrysler, Convair Division of General Dynamics, Douglas, Firestone Tire and Rubber, Lockheed, and Sperry Rand.
162. Evert Clark, "Army Modifies Arsenal Concept; Pershing Contract Goes to Martin," *Aviation Week* 68, no. 13 (31 March 1958): 20; Clark, "Industry's Missile Role," 52-53; Satterfield and Akens, *Government-Contractor Relationships*, 8; and Jolliff, *Pershing Weapon System*, 22. In June 1958, when a definitive contract was agreed upon, funding was increased to $18,727,000. By the time the contract had run its course, its value had grown to nearly $453 million (Jolliff, 22).
163. Clark, "Industry's Missile Role," 53, 56; and Jolliff, *Pershing Weapon System*, 23, 25-26.
164. Satterfield and Akens, *Government-Contractor Relationships*, 40-41.
165. Jolliff, *Pershing Weapon System*, 97-98, 227-29.
166. Medaris address, "Missile Procurement," 16 June 1959, 10.

I. Sources: Medaris' official biography, Office of Public Information, Department of Defense, n.d., copy in Biographical Files, U.S. Army Center of Military History library and archives; "They Shine in a Rocket's Bright Glare," *Time* 71, no. 6 (10 February 1958): 18; Michael J. Neufeld, "The End of the Army Space Program: Interservice Rivalry and the Transfer of the von Braun Group to NASA, 1958–1959," *The Journal of Military History* 69, no. 3 (July 2005): 742 (Glennan quotation); and *Washington Post*, 10 February 1989: C3 (Beggs quotation).

CHAPTER XII

Conclusion

Following World War II, American leaders, supported by the public, determined to maintain national security through a policy and strategy that relied on technologically superior weapons to overcome the numerical advantages in equipment and personnel estimated to be possessed by likely military opponents. It would be difficult to overstate the consequences of this consensus for the acquisition of major weapon systems. In addition to determining the kinds of weapons to be acquired, it shaped the relationship between the Office of the Secretary of Defense and the military services, organizational evolution in both, and the methods employed to develop, produce, and field new weapons. It also made permanent the government-science-industry alliance that had been forged during the war.

Advanced technology weapons were expensive and their costs rose sharply after World War II. The average unit flyaway cost of Air Force strategic bombers illustrates the trend: for a World War II B–29, $600,000; for a Korean War era B–36, $4 million; and, near the end of the 1950s, over $7.5 million for a B–52, a more than tenfold increase (in constant dollars) in program costs in 15 years.[1] The rapidly accelerating use of electronics was a major part of higher price tags for weapons. For example, in 1959, as noted in the chapter on the post-Korean War Navy, electronic systems accounted for almost 40 percent of the cost of one of its combat ships.

From the mid-1940s through the 1950s, the rising cost of complex weapon systems and of defense, generally, presented a challenge to the Truman and Eisenhower administrations, both of which sought to limit military spending. Since the two policy goals—relying on cutting-edge weapon systems for security and holding down the budget—could not be realized at the same time, the secretary of defense and the service secretaries (particularly the latter) were often caught between the president who appointed them and the military services that they represented. The dilemma led to conflicts, sometimes between the secretary of defense and the military departments, as illustrated by the response of the Navy's civilian and uniformed leadership to Secretary of Defense Johnson's cancellation of the supercarrier *United States*; and sometimes between the service secretaries and their top military officers, as exemplified by the dispute between Secretary of the Army Pace and General Collins, the chief of staff, over the priority to be given to development of the Ontos antitank weapon system.

The perception that the high cost of weapons stemmed from interservice rivalry and a resulting unnecessary duplication in weapons programs had been a key factor in naming a single civilian secretary to head the National Military Establishment in 1947. It also stimulated the effort to centralize more power and authority in the Office of the Secretary of Defense at the expense of the services from that time through the end of the 1950s.

Changes in the structure of organization for acquisition in OSD reflected the centralizing trend. By the end of the Truman administration, widespread agreement existed that the Research and Development Board and the Munitions Board—the framework established by the National Security Act of 1947 to provide policy direction and coordination to acquisition—had to be replaced. On the one hand, many in Congress, in the scientific community, and even officials within the Truman administration had concluded that the boards were ineffective. On the other hand, the services, less concerned about effectiveness and more concerned about their own prerogatives, complained that acquisition had become too centralized under the boards—that they had become "operators," intruding into the sphere of program administration that by law was reserved for the military departments.

In 1953, President Eisenhower, a strong backer of service unification and the authority of the secretary of defense, endorsed a reorganization of the Defense Department designed both to enhance the authority of the secretary of defense and to satisfy to a certain extent the services' objections. The plan replaced the nominally independent, but in reality service-dominated boards with assistant secretaries who, working directly for the secretary of defense, would formulate acquisition policy and oversee the services' acquisition programs. Four assistant secretaries—research and development, applications engineering, supply and logistics, and properties and installations—absorbed the acquisition functions formerly carried out by the boards. But with only small staffs, the assistant secretaries were not expected or able to become involved in acquisition operations.

The 1953 reorganization did not work. The division of responsibility for research and development between an assistant secretary of defense for research and development and an assistant secretary for applications engineering resulted in a long and bitter rivalry between the two that left the Office of the Secretary of Defense in a weaker position vis-à-vis the services than under the board system. The imbalance was partially redressed by the Department of Defense Reorganization Act of 1958, which significantly strengthened OSD's control of research and development. The newly created position of director of defense research and engineering exercised extensive authority over military R&D and could independently initiate research and development programs through the Advanced Research Projects Agency.

The consensus for a security policy and strategy emphasizing advanced weapon systems also significantly affected acquisition organization within the services. After World War II, many scientists, and some civilian and military leaders in the military establishment, argued that if research and development continued to be subordinated to production as was the case during the war, the services would be unable to develop the technologically superior weapons needed to assure national security. To ensure that R&D would have the necessary independence and importance, they urged that its management be separated organizationally from production. This conviction led to disputes over organizational structure that affected each service and continued for a decade and a half. By 1960, after protracted internal conflicts, the Army and Navy had granted R&D organizational separation and equality in both their headquarters' secretariats and military staffs.

The Air Force went further and faster than the Army and Navy in giving R&D greater organizational clout. Unlike the two older services, it lacked entrenched and long-lived acquisition organizations, making organizational change easier. In 1950, the proponents of independence for research and development in the Air Force achieved their objective with the creation of the position of the deputy chief of staff for development on the Air Staff and the Air Research and Development Command in the field, which limited the deputy chief of staff for materiel and the Air Materiel Command, previously responsible for all acquisition functions, to production. Still, the Air Force's R&D community, a strong advocate of the systems approach to weapons acquisition, in which research, development, and production were viewed as interrelated elements of a seamless process, was not satisfied. For the next ten years, it sought to wrest control of production from the deputy chief of staff for materiel and the Air Materiel Command, succeeding finally with the establishment of the Air Force Systems Command in 1961.

The complexity of modern weapons, the speed at which new technologies appeared, and the pressure to produce advanced systems rapidly affected the established service acquisition organizations in another important way. To develop and field such systems in time to maintain an edge over opposing armed forces demanded a measure of central planning and direction, and close coordination throughout the acquisition process. The Army's technical services and the Navy's material bureaus were product-oriented, but the weapons they developed, such as missiles, high-performance aircraft, or other electronic-based systems, increasingly cut across institutional boundaries. Thus, throughout the 1950s, each of these services struggled to coordinate better the work of its development agencies. The problem was less acute in the Army than the Navy because, in the former, a requirement for relatively fewer different types of systems meant less need for interorganizational cooperation on weapons development. Even so, by the end of the decade, the Army was becoming more aware of problems caused by its decentralized and fragmented acquisition structure, though there were as yet no calls to abolish or even significantly modify the technical service system. In contrast, by the mid-1950s, many Navy leaders had become dissatisfied with the responsiveness of the bureaus. The establishment of the Special Projects Office for the Polaris system was a clear indication that the service's top leadership lacked confidence in them. But rather than overturning the bureau structure, the Navy sought to preserve it by adjusting procedures, transferring more power over acquisition to the staff of the chief of naval operations (OPNAV), and carrying out only modest organizational change—merging the Bureau of Aeronautics and the Bureau of Ordnance into the Bureau of Naval Weapons in 1959.

In developing new weapons, the Air Force found that not only the existence of two field commands that divided acquisition responsibilities, but also the horizontal and functional organizational patterns present in both tended to complicate and delay the process. To overcome these difficulties, the Air Force pioneered the use of an organizational structure that drew together functional specialists from both commands in a project-type organization for each major weapon system. With only a few exceptions, principally the Special Projects Office in the Navy and the Ballistic Missile Agency in the Army, the other two services did not adopt this organizational arrangement for weapon system development in the 1950s.

In addition to introducing new organizational frameworks, the Air Force also initiated significant changes in the acquisition process by adopting the weapon system approach. As practiced by the Air Force, this concept involved central design and direction of new weapon systems, the application of the strategy of concurrency throughout the acquisition cycle, managing development and production through a project structure, and assigning industry the primary responsibility for both development and production. The Air Force first executed the systems approach, but only partially, in the F–102 fighter program, and then completely in the acquisition of the B–58 supersonic bomber and the Atlas, Titan, and Thor ballistic missiles. By the end of the 1950s, all major Air Force acquisition programs employed the systems approach.

Concurrency was central to the Air Force's employment of the weapon system concept. Before World War II, the Army and Navy had used a deliberate, sequential approach in acquiring new systems, with each stage of the process—research, development, testing of prototypes, and production—generally proceeding in series. The need to field systems rapidly in World War II inspired some use of the acquisition strategy, eventually called concurrency, in which development and production overlapped. Between World War II and the start of the Korean War, the Air Force and Navy used both sequential and concurrent acquisition strategies. Concurrency's principal advantage was that it cut the time required to field a new system equipped with the most advanced technology. But since development was not complete when production began, expensive and time-consuming modifications often had to be made to systems already in production or even deployed to operating units. As a result, costs rose and schedules slipped. A sequential strategy avoided these problems but, in the face of rapidly advancing technology, the nominally longer acquisition cycle risked early obsolescence or worse, inferiority. The Army, with little research and development money available for acquiring new systems (there was only enough to buy a few prototypes), concentrated on developing subsystems that it believed would establish a foundation for fielding complete systems quickly when funds became available.

When the money spigot opened wide in 1950, all the services adopted concurrency to field advanced systems as rapidly as possible. Haste was necessary, since plans called for the armed forces to be ready to fight a global war with the Soviet Union as early as mid-1952. Widespread use of concurrency resulted in many new weapon systems that required costly modifications during production and into deployment, and experienced schedule delays, or even cancellation. In many cases, the net results were higher costs and no real improvement in the effort to field effective systems rapidly. In late 1952, one Army staff officer declared, "No satisfactory telescoping of development, test, and production of any armored vehicle has been accomplished to date."[2]

To many, the lesson of program accelerations in the Korean War seemed clear: the practice was expensive and did not usually save time. Dedicated to efficiency and economy, the Eisenhower administration did not prohibit concurrency but tended to discourage its use, insisting that systems be proven by testing before quantity production was initiated ("fly before buy" or "try before buy"). In an attempt to preserve concurrency's advantages but avoid its pitfalls, the Wilson Defense Department established a policy that called for a low rate of initial production to acquire sufficient test vehicles. Once the system was proven, then quantity production could begin. The Air Force, followed by the Navy, had already begun to implement such an approach, but the services' principal objective was to provide operational units combat-ready systems equipped with the most advanced technology in the shortest possible time, not to save money.

Concurrency as applied in the Air Force's weapon system approach involved more than overlapping development and production. According to the head of the Air Force's ballistic missile program in 1959, it meant "everybody moving forward with everything all at once." Each element of the weapon system was to be part of a single plan, program, and budget, and "implemented concurrently, in unison, consistent with lead time requirements."[3] In other words, in addition to development and production, concurrency included other aspects of system acquisition, such as operator training and construction of support facilities. In the late 1950s, this broader notion of concurrency applied to all Air Force weapon system programs and was institutionalized in Air Force regulations in the summer and fall of 1960. But with the exception of the Special Projects Office and the programs conducted by the Army Ballistic Missile Agency, the other services did not make across-the-board use of the more expansive notion of concurrency.

Although most observers agreed that the narrower application of concurrency (i.e., overlapping development and production) during the Korean

War to "crash" programs involving designs that included technologies still under development had failed, the verdict regarding the broader notion of the concept was less clear. It did not work in the Air Force's F–102 and B–58 programs, largely because the uncertainties inherent in the development of advanced technologies generated design changes that resulted in schedule delays and sharply increased costs. But in the Air Force's Atlas, Titan, and Thor and the Navy's Polaris ballistic missile programs, concurrency appeared to be a stunning success. By the early 1960s, it was the preferred acquisition strategy for all major DoD weapon systems. Few acknowledged, however, that almost unlimited funding and top priorities had enabled the ICBM and IRBM efforts to overcome obstacles that could not be surmounted by less important and less well-endowed programs.

In addition to concurrency, another element of the Air Force's approach to acquiring new weapons—assigning most of the responsibility to industry—also distinguished its acquisition practices from those of the other services. Lacking significant in-house research and development capabilities, the Air Force was forced to turn to industry and the academic community for needed expertise. Under its single prime contractor, or weapon system procurement approach, the Air Force assigned almost complete responsibility to an industrial contractor for planning, developing, and producing new systems. The other services, possessing substantial research and development expertise and facilities of their own, moved more slowly in granting industry such increased authority, although there were important exceptions. For example, in 1946, Western Electric's Bell Telephone Laboratories took the lead in the Army's Nike antiaircraft missile program, assuming responsibility for most system research and development, exercising subcontracting authority, and performing system integration—functions all normally carried out by Army organizations.

The constant pressure to develop and produce superior weapons rapidly and in significant numbers spurred the growth of a large acquisition workforce in the Department of Defense. Although debates over organizational structures in the services for acquiring new weapons drew most of the attention during the 1950s, there was increased recognition that successful weapons programs depended heavily on the qualifications of the military and civilian government employees who were involved in requirements formulation, research and development, production, and contracting. Observers, largely from outside the military establishment, like the Riehlman subcommittee in 1954 and the Hoover Commission in 1955, but also from within the Defense Department, like the Robertson committee in 1956–1957, recommended numerous ways to improve the quality and effectiveness of the acquisition workforce. Among the measures suggested were longer tour lengths for military officers, greater opportunities for officers specializing in acquisition and for civilians to hold the top positions in those fields, and the institution of career development programs for both the military and civilians.

Already convinced of the necessity to upgrade the acquisition workforce, OSD issued directives to implement many of the recommendations. But the services, with different priorities with respect to personnel policy, particularly their desire to ensure the continued dominance of officers from the combat arms, moved slowly on the new policies or avoided carrying them out entirely.

Along with its profound impact on the armed forces, basing national security on the development of technologically superior weapon systems also had far-reaching consequences for American science and industry. The pursuit of advanced weapons technologies led to research and development's becoming a large and distinguishable defense function that absorbed a steadily increasing share of the military budget. In addition to tens of thousands of Department of Defense military and civilian personnel, R&D work enlisted a substantial portion of the nation's scientists and engineers who supported the weapons acquisition effort by working on government contracts with industry and universities, or who served as advisors to the president, OSD, or the services on numerous boards and committees.

Industry—the major partner with government in weapons acquisition—was transformed by the relationship. Companies that specialized in a single type of product (aircraft, surface vessel or submarine, tank or truck) began to acquire capabilities in new technologies such as missiles or electronics that increased their attractiveness to the Department of Defense. Firms that remained one-dimensional were less fortunate; some consolidated with other companies or exited the defense industry entirely. Finally, new business enterprises appeared, such as the Ramo-Wooldridge Corporation, that for a while produced no hardware themselves but integrated subsystems developed by others into complete systems.

Many post–World War II defense industries did not fit the usual definition of capitalist economic activity. For one thing, impersonal market forces did not determine prices and profits; those were usually negotiated between buyer and seller, with the former assuming much of the latter's traditional risk. For another, the government often paid for much of industry's equipment and physical plant. At the same time, government was able to exercise extraordinary leverage on firms dependent for survival on defense contracts, sometimes even intervening in the selection of top-level company officials.

The continuation of contracting practices and government assistance instituted just before or during World War II, such as negotiated sole-source and cost-reimbursement contracts, the extension of advance and progress payment and tax breaks, and government financing of equipment and facilities, were powerful lures that attracted science and industry to defense work. Simon Ramo, who along with Dean Wooldridge, founded the Ramo-Wooldridge Corporation, and later TRW, has explained how these incentives made weapons development good business for Hughes Aircraft, a subsidiary of the Hughes Tool Company:

> The work was accomplished under "cost-plus" contracting, with all expenses applicable to the effort reimbursed by the government, and with a fee, a gross profit, added on top. It was essentially impossible to lose money. . . . Special facilities, buildings, laboratories, test equipment, etc., needed to meet the contract were all chargeable to it, if not as an expense paid for immediately, then as a capital item that would be written off quickly through depreciation charges covered by the contract. Working capital needs were minimized because the government made generous cash payments as the work progressed. If more cash was needed, it could be readily borrowed from the banks because the government provided loan guarantees. Thus the Hughes Tool Company took on only infinitesimal financial risks from the mushrooming business of Hughes Aircraft. The profitable return, in proportion to the small real investment, was extraordinary.[4]

Before the end of the 1950s, the U.S. government sought to transfer some of the risk in weapons programs back to the contractor through employment of incentive contracts that were tied to both cost reduction and technical performance. This trend continued in the next decade as the government increased the use of incentive contracting and substituted fixed-price for cost-reimbursement contracts.

By 1960, the government-science-industry partnership, labeled the "military-industrial complex" by departing President Eisenhower, was well established. In this arena, the services continued to play the leading role. Although OSD's power had increased since 1947, it was still being applied episodically. With the advent of the Kennedy administration and Robert McNamara's ascendancy at the Defense Department, however, OSD would increasingly intrude upon the military services' traditional acquisition prerogatives in a much more thorough and systematic way.

Endnotes

1. Table 13 (Average Cumulative Flyaway Cost Per Aircraft, Selected Models), 25 August 1958, atch to "The Impact of Increasing Costs on the Defense Budget," encl. to ltr, Max Lehrer, Director, Economic and Fiscal Analysis Division, Office of the Secretary of Defense, to Robert Wright, Foreign Affairs Division, Legislative Reference Service, Library of Congress, 10 September 1959, folder Miscellaneous Costs, box 34, Miscellaneous Files, 1950–1961, Assistant Secretary of Defense (Comptroller), RG 330, OSD/HO.
2. Memorandum for record [of meeting in the Office of the Acting Deputy Chief of Staff for Operations and Administration, 18 August 1952], Col. W. S. Triplet, Chief, Development Branch, Research and Development Division, G–4, 20 August 1952, sub: The Pros and Cons of Telescoping the Development, Testing and Procurement of BAT and Ontos, folder 470.8, box 831, entry 2 (Records of the Office of the Chief of Staff, Decimal File), RG 319.
3. Maj. Gen. Osmond J. Ritland, "Concurrency," *Air University Quarterly Review* 12, nos. 3 and 4 (Winter and Spring 1960–1961): 240.
4. Simon Ramo, *The Business of Science: Winning and Losing in the High-Tech Age*, 44.

Appendix I

ACTIVE FORCES
FY 1947–1953

FY	1947	1948	1949	1950	1951	1952	1953
ARMY							
Divisions [1]	12 (12R)	11 (11R)	10 (10R)	10 (9R)	17 (3R)	19 (5R)	19
Regiments [1]	19 (19R)	9 (9R)	11 (11R)	12 (11R)	18 (10R)	18 (13R)	18
Personnel [2]	685	554	660	593	1,532	1,596	1,534
NAVY							
Major Combatant Vessels	297	277	272	238	342	400	409
Attack Carriers	11	11	11	7	12	14	14
Marine Divisions/ Wings [1]	2 (2R)/2	2 (2R)/2	2 (2R)/2	2 (2R)/2	2⅓/2	3/3	3/3
Personnel [2,3]	591	503	534	455	930	1,056	1,043
AIR FORCE							
Groups/Wings	38	55	59	48	87	95	106⅔
Personnel [2]	306	388	419	411	788	983	978
Total Personnel [2]	1,582	1,445	1,613	1,459	3,250	3,635	3,555

ACTIVE FORCES
FY 1954–1961

FY	1954	1955	1956	1957	1958	1959	1960	1961
ARMY								
Divisions [1]	18	19	20	19 (3R)	17	16	15	15
Regiments	18	12	10	9	5	5	5	6
Personnel [2]	1,405	1,109	1,026	998	899	862	873	859
NAVY								
Major Combatant Vessels	405	402	404	409	396	386	376	375
Attack Carriers	14	15	15	14	14	14	14	14
Marine Divisions/ Wings	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3
Personnel [2,3]	950	866	871	877	829	802	788	803
AIR FORCE								
Wings	115⅓	121	131	137	103	105	96	88
Personnel [2]	948	960	910	920	871	840	815	821
Total Personnel [2]	3,303	2,935	2,807	2,795	2,599	2,504	2,476	2,483

1. R = Reduced strength. Table reflects Army divisions that were technically active on 30 June of the fiscal year. Thus, on 30 June 1947, the 3d Infantry Division numbered 164 personnel, and on 30 June 1948, 28 personnel.
2. Personnel figures (in thousands).
3. Includes Marine Corps personnel.

Sources: Progress Reports and Statistics, Office of the Secretary of Defense, 6 April 1949, Changes in the Army, 30 June 1947–30 June 1950, 2, 4, 11-12; Progress Reports and Statistics, Office of the Secretary of Defense, 28 March 1949, Changes in the Navy, 30 June 1947–30 June 1950, 5, 14: memo, W. H. Mautz, Office of Progress Reports and Statistics, Office of the Secretary of Defense, for Mr. Forrestal, 4 March 1949, Changes in the Air Force, 30 June 1947-30 June 1950, 7, 14: all encls. to memo, Maj. Gen. Edmond H. Leavey, Army Comptroller, for Secretary, General Staff, 25 April 1949, sub: Changes in the Army, Navy, and Air Force, 30 June 1947 to 30 June 1950, folder 320, Unification, box 121, entry 26, RG 335; table 8 (Navy Operating Forces, Fiscal Years 1947–1949), in Jeffrey G. Barlow, *Revolt of the Admirals: The Fight for Naval Aviation, 1945–1950*, 161; William D. Parker, *A Concise History of the Marine Corps, 1775–1969*, 74-77; table 4, (Forces in Being, 1950–1952), in Walter S. Poole, *The Joint Chiefs of Staff and National Policy*, Vol. IV, *1950–1952*, 71; Semiannual Report of the Secretary of the Navy, January 1, 1953, to June 30, 1953, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1953*, 174; table 8 (Actual Force Levels of U.S. Armed Forces: 1952–1956), in Robert J. Watson, *The Joint Chiefs of Staff and National Policy*, Vol. V, *1953–1954*, 84; table 4 (Major Forces in Being, 1954–1957), in Kenneth W. Condit, *The Joint Chiefs of Staff and National Policy*, Vol. VI, *1955–1956*, 56; Semiannual Report of the Secretary of the Army, January 1, 1958, to June 30, 1958, in Department of Defense, *Semiannual Report of the Secretary of Defense, January 1 to June 30, 1958*, 105; Annual Report of the Secretary of the Army, July 1, 1958, to June 30, 1959, in Department of Defense, *Annual Report of the Secretary of Defense, July 1, 1958 to June 30, 1959*, 116-18; Byron R. Fairchild and Walter S. Poole, *The Joint Chiefs of Staff and National Policy,* Vol. VII, *1957-1960*, 38, 40; Annual Report of the Secretary of the Army, July 1, 1960, to June 30, 1961, in Department of Defense, *Annual Report for Fiscal Year 1961*, 66-68; Annual Report of the Secretary of the Navy, July 1, 1960, to June 30, 1961, in Department of Defense, *Annual Report for Fiscal Year 1961*, 197; and table 4 (Department of Defense Manpower, FY 1940–2005), in *Department of Defense Key Officials, 1947–2004*, 90.

Appendix II

KEY ACQUISITION OFFICIALS, 1945–1961

Secretaries of War

Robert P. Patterson	September 1945–July 1947
Kenneth C. Royall	July 1947–September 1947

Secretary of the Navy

James V. Forrestal	May 1944–September 1947

Assistant Secretaries of War, Air

Robert A. Lovett	April 1941–December 1945
W. Stuart Symington	February 1946–September 1947

Secretaries of Defense

James V. Forrestal	September 1947–March 1949
Louis A. Johnson	March 1949–September 1950
George C. Marshall	September 1950–September 1951
Robert A. Lovett	September 1951–January 1953
Charles E. Wilson	January 1953–October 1957
Neil H. McElroy	October 1957–December 1959
Thomas S. Gates, Jr.	December 1959–January 1961

Deputy Secretaries of Defense

Stephen T. Early	May 1949–August 1949 (Under Secretary of Defense) August 1949–September 1950
Robert A. Lovett	October 1950–September 1951
William C. Foster	September 1951–January 1953
Roger M. Kyes	February 1953–May 1954
Robert B. Anderson	May 1954–August 1955
Reuben B. Robertson, Jr.	August 1955–April 1957
Donald A. Quarles	May 1957–May 1959
Thomas S. Gates, Jr.	June 1959–December 1959
James H. Douglas, Jr.	December 1959–January 1961

Chairmen, Research and Development Board

Vannevar Bush	September 1947–October 1948
Karl T. Compton	October 1948–March 1950
William Webster	March 1950–July 1951
Walter G. Whitman	August 1951–June 1953

Assistant Secretaries of Defense (Research and Development)

Donald A. Quarles	September 1953–August 1955
Clifford C. Furnas	December 1955–February 1957

Assistant Secretary of Defense (Applications Engineering)

Frank D. Newbury	August 1953–March 1957

Assistant Secretaries of Defense (Research and Engineering)

Frank D. Newbury	March 1957–May 1957
Paul D. Foote	September 1957–October 1958

Director of Defense Research and Engineering

Herbert F. York	December 1958–April 1961

Chairmen, Munitions Board

Thomas J. Hargrave	September 1947–September 1948
Donald F. Carpenter	September 1948–June 1949
Hubert E. Howard	November 1949–September 1950
John D. Small	November 1950–January 1953

Assistant Secretaries of Defense (Supply and Logistics)

Charles S. Thomas	August 1953–May 1954
Thomas P. Pike	May 1954–June 1956
E. Perkins McGuire	December 1956–January 1961

Chairmen, Joint Chiefs of Staff

General of the Army Omar N. Bradley, USA	August 1949–August 1953
Adm. Arthur W. Radford, USN	August 1953–August 1957
Gen. Nathan F. Twining, USAF	August 1957–September 1960
Gen. Lyman L. Lemnitzer, USA	October 1960–September 1962

Secretaries of the Army

Kenneth C. Royall	September 1947–April 1949
Gordon Gray	June 1949–April 1950
Frank Pace, Jr.	April 1950–January 1953

Robert T. Stevens	February 1953–July 1955
Wilber M. Brucker	July 1955–January 1961

Under Secretaries of the Army

William H. Draper, Jr.	September 1947–February 1949
Gordon Gray	May 1949–June 1949
Tracy S. Voorhees	August 1949–April 1950
Archibald S. Alexander	May 1950–April 1952
Karl R. Bendetsen	May 1952–October 1952
Earl D. Johnson	October 1952–January 1954
John Slezak	February 1954–January 1955
Charles G. Finucane	February 1955–April 1958
Hugh M. Milton II	August 1958–January 1961

Assistant Secretaries of the Army

Gordon Gray	September 1947–May 1949
Tracy S. Voorhees	June 1948–August 1949
Archibald S. Alexander	August 1949–May 1950
Karl R. Bendetsen (General Mgmt)	February 1950–May 1952
Earl D. Johnson (Research and Materiel after 7 May 1952)	May 1950–October 1952
John Slezak (Materiel)	May 1953–February 1954
Frank Higgins (Logistics and Research and Development — Logistics from 21 July 1955)	August 1954–March 1959
William Martin (Director of Research and Development)	August 1955–May 1959
Courtney Johnson (Logistics)	April 1959–January 1961
Richard S. Morse (Director of Research and Development — ASA from 3 March 1961)	June 1959–May 1961

Chiefs of Staff

General of the Army George C. Marshall	September 1939–November 1945
General of the Army Dwight D. Eisenhower	November 1945–February 1948
Gen. Omar N. Bradley	February 1948–August 1949
Gen. J. Lawton Collins	August 1949–August 1953
Gen. Matthew B. Ridgway	August 1953–June 1955
Gen. Maxwell D. Taylor	June 1955–June 1959
Gen. Lyman L. Lemnitzer	July 1959–September 1960
Gen. George H. Decker	October 1960–September 1962

Deputy Chiefs of Staff

Lt. Gen. Thomas T. Handy	October 1944–August 1947
Lt. Gen. J. Lawton Collins	September 1947–November 1948

Vice Chiefs of Staff

Lt. Gen. J. Lawton Collins	November 1948–August 1949
Gen. Wade H. Haislip	August 1949–July 1951
Gen. John E. Hull	August 1951–October 1953
Gen. Charles L. Bolté	October 1953–April 1955
Gen. Williston B. Palmer	May 1955–May 1957
Gen. Lyman L. Lemnitzer	July 1957–June 1959
Gen. George H. Decker	August 1959–September 1960
Gen. Clyde D. Eddleman	November 1960–March 1962

Directors of Service, Supply, and Procurement

Lt. Gen. LeRoy Lutes	June 1946–January 1948
Lt. Gen. Henry S. Aurand	January 1948–February 1948

Directors of Logistics

Lt. Gen. Henry S. Aurand	February 1948–March 1949
Lt. Gen. Thomas B. Larkin	March 1949–February 1950

Assistant Chiefs of Staff, G–4, Logistics

Lt. Gen. Thomas B. Larkin	March 1950–December 1952
Lt. Gen. Williston B. Palmer	December 1952–September 1954

Deputy Chiefs of Staff for Logistics

Lt. Gen. Williston B. Palmer	September 1954–April 1955
Lt. Gen. Carter B. Magruder	May 1955–July 1959
Lt. Gen. Robert W. Colglazier, Jr.	July 1959–July 1964

Research and Development Division

Lt. Gen. Henry S. Aurand	June 1946–January 1948

Deputy Chiefs of Staff for Plans and Research

Lt. Gen. Charles L. Bolté	January 1952–July 1952
Lt. Gen. Lyman L. Lemnitzer	August 1952–March 1955
Lt. Gen. James M. Gavin	March 1955–October 1955

Chiefs of Research and Development

Lt. Gen. James M. Gavin	October 1955–March 1958
Lt. Gen. Arthur G. Trudeau	April 1958–June 1962

Chiefs of Ordnance

Maj. Gen. Everett S. Hughes	June 1946–October 1949
Maj. Gen. Elbert L. Ford	November 1949–October 1953
Maj. Gen. Emerson L. Cummings	November 1953–February 1958
Lt. Gen. John H. Hinrichs	February 1958–May 1962

Chief Signal Officers

Maj. Gen. Spencer B. Akin	April 1947–March 1951
Maj. Gen. George I. Back	May 1951–April 1955
Lt. Gen. James D. O'Connell	May 1955–April 1959
Maj. Gen. Ralph T. Nelson	May 1959–June 1962

Chiefs of the Chemical Corps

Maj. Gen. Alden H. Waitt	November 1945–September 1949
Maj. Gen. Anthony C. McAuliffe	October 1949–July 1951
Maj. Gen. Egbert F. Bullene	August 1951–March 1954
Maj. Gen. William M. Creasy	May 1954–August 1958
Maj. Gen. Marshall Stubbs	September 1958–July 1962

Chiefs of the Transportation Corps

Maj. Gen. Edmund H. Leavey	December 1945–June 1948
Maj. Gen. Frank A. Heileman	June 1948–March 1953
Maj. Gen. Paul F. Yount	April 1953–January 1958
Maj. Gen. Frank S. Besson, Jr.	March 1958–March 1962

Army Service Forces

Lt. Gen. Brehon B. Somervell	March 1942–December 1945
Lt. Gen. LeRoy Lutes	January 1946–June 1946

United States Continental Army Command

Lt. Gen. Jacob L. Devers	July 1945–September 1949
Gen. Mark W. Clark	October 1949–May 1952
Gen. John R. Hodge	May 1952–June 1953
Gen. John E. Dahlquist	August 1953–February 1956
Gen. Willard G. Wyman	March 1956–July 1958
Gen. Bruce C. Clarke	August 1958–September 1960
Gen. Herbert B. Powell	October 1960–January 1963

Secretaries of the Navy

John L. Sullivan	September 1947–May 1949
Francis P. Matthews	May 1949–July 1951
Dan A. Kimball	July 1951–February 1953
Robert B. Anderson	February 1953–May 1954

Charles S. Thomas	May 1954–March 1957
Thomas S. Gates, Jr.	April 1957–June 1959
William B. Franke	June 1959–January 1961

Under Secretaries of the Navy

John L. Sullivan	June 1946–September 1947
W. John Kenney	September 1947–September 1949
Dan A. Kimball	May 1949–31 July 1951
Francis P. Whitehair	August 1951–January 1953
Charles S. Thomas	February 1953–August 1953
Thomas S. Gates, Jr.	October 1953–April 1957
William B. Franke	April 1957–June 1959
Fred A. Bantz	June 1959–January 1961

Assistant Secretaries of the Navy

H. Struve Hensel	January 1945–February 1946
W. John Kenney	March 1946–September 1947
Mark E. Andrews	January 1948–February 1949
John T. Koehler	February 1949–October 1951
Herbert R. Askins	October 1951–January 1953
Raymond H. Fogler	June 1953–October 1954

Assistant Secretaries of the Navy (Material)

Raymond H. Fogler	November 1954–January 1957
Fred A. Bantz	April 1957–April 1959
Cecil P. Milne	April 1959–January 1961

Assistant Secretaries of the Navy (Air)

John L. Sullivan	July 1945–June 1946
John N. Brown	November 1946–March 1949
Dan A. Kimball	March 1949–May 1949
John F. Floberg	December 1949–July 1953
James H. Smith, Jr.	July 1953–June 1956
Garrison R. Norton	June 1956–February 1959

Assistant Secretary of the Navy (Research and Development)

James H. Wakelin, Jr.	June 1959–June 1964

Chiefs of Naval Operations

Fleet Admiral Chester W. Nimitz	December 1945–December 1947
Adm. Louis Denfeld	December 1947–November 1949
Adm. Forrest P. Sherman	November 1949–July 1951
Adm. William M. Fechteler	August 1951–August 1953

Adm. Robert B. Carney	August 1953–August 1955
Adm. Arleigh A. Burke	August 1955–August 1961

Commandants of the Marine Corps

Gen. Alexander A. Vandegrift	January 1944–December 1947
Gen. Clifton B. Cates	January 1948–December 1951
Gen. Lemuel C. Shepherd, Jr.	January 1952–December 1955
Gen. Randolph McC. Pate	January 1956–December 1959
Gen. David M. Shoup	January 1960–December 1963

Vice Chiefs of Naval Operations

Adm. Richard S. Edwards, Jr.	October 1945–December 1945
Adm. DeWitt C. Ramsey	January 1946–January 1948
Adm. Arthur W. Radford	January 1948–May 1949
Adm. John D. Price	May 1949–April 1950
Adm. Lynde D. McCormick	April 1950–August 1951
Adm. Donald B. Duncan	August 1951–August 1956
Adm. Harry D. Felt	August 1956–June 1958
Adm. James S. Russell	July 1958–November 1961

Deputy Chiefs of Naval Operations, Logistics

Vice Adm. William S. Farber	October 1945–February 1946
Vice Adm. Robert B. Carney	April 1946–February 1950
Vice Adm. Francis S. Low	February 1950–April 1953
Vice Adm. Roscoe F. Good	April 1953–March 1956
Rear Adm. Herbert G. Hopwood	April 1956–January 1958
Vice Adm. Ralph E. Wilson	January 1958–July1960

Assistant Chief of Naval Operations (Research and Development)

Rear Adm. John T. Hayward	October 1957–April 1959

Deputy Chief of Naval Operations, Development

Vice Adm. John T. Hayward	April 1959–March 1962

Chiefs, Material Division/Chiefs of Naval Material

Vice Adm. Ben Moreell	November 1945–November1946
Vice Adm. Edward L. Cochrane	November 1946–August1947
Vice Adm. Arthur C. Miles	August 1947–September 1949
Vice Adm. Edwin D. Foster	October 1949–December1950
Vice Adm. Albert G. Noble	January 1951–September 1951
Vice Adm. Charles W. Fox	October 1951–July1953
Vice Adm. John E. Gingrich	August 1953–September 1954
Vice Adm. Murrey L. Royar	1955–April 1956

Vice Adm. Edward W. Clexton	February 1956–June 1960
Vice Adm. George F. Beardsley	July 1960–June 1963

Chiefs of Naval Research

Vice Adm. Harold G. Bowen	July 1945–October 1946
Rear Adm. Paul F. Lee	November 1946–June 1948
Rear Adm. Thomas A. Solberg	July 1948–June 1951
Rear Adm. C. M. Bolster	August 1951–December 1953
Rear Adm. F. R. Furth	January 1954–January 1956
Rear Adm. Rawson Bennett II	January 1956–January 1961

Chiefs, Bureau of Aeronautics

Rear Adm. Harold B. Sallada	June 1945–May 1947
Rear Adm. Alfred M. Pride	May 1947–May 1951
Rear Adm. Thomas S. Combs	May 1951–June 1953
Rear Adm. Apollo Soucek	June 1953–March 1955
Rear Adm. James S. Russell	March 1955–July 1957
Rear Adm. Robert E. Dixon	July 1957–December 1959

Chiefs, Bureau of Ordnance

Vice Adm. George F. Hussey, Jr.	December 1943–September 1947
Rear Adm. Albert G. Noble	September 1947–late 1950
Rear Adm. Malcolm F. Schoeffel	January 1951–January 1955
Rear Adm. Frederic S. Withington	February 1955–February 1958
Rear Adm. Paul D. Stroop	March 1958–September 1959
Rear Adm. M. S. Hubbard	September 1959–December 1959

Chiefs, Bureau of Ships

Vice Adm. Edward L. Cochrane	November 1942–November 1946
Vice Adm. Earle W. Mills	November 1946–February 1949
Rear Adm. David H. Clark	March 1949–January 1951
Rear Adm. Homer N. Wallin	February 1951–August 1953
Rear Adm. Wilson D. Leggett, Jr.	August 1953–March 1955
Rear Adm. Albert G. Mumma	April 1955–March 1959
Rear Adm. Ralph K. James	April 1959–March 1963

Chief, Bureau of Naval Weapons

Rear Adm. Paul D. Stroop	September 1959–October 1962

Secretaries of the Air Force

W. Stuart Symington	September 1947–April 1950
Thomas K. Finletter	April 1950–January 1953
Harold E. Talbott	February 1953–August 1955

Donald A. Quarles	August 1955–April 1957
James H. Douglas, Jr.	May 1957–December 1959
Dudley C. Sharpe	December 1959–January 1961

Under Secretaries of the Air Force

Arthur S. Barrows	September 1947–April 1950
John A. McCone	June 1950–October 1951
Roswell L. Gilpatric	October 1951–February 1953
James H. Douglas, Jr.	March 1953–April 1957
Malcolm A. MacIntyre	June 1957–July 1959
Dudley C. Sharp	August 1959–December 1959
Joseph V. Charyk	January 1960–March 1963

Assistant Secretaries of the Air Force (Materiel)

Roswell L. Gilpatric	May 1951–October 1951
Edwin V. Huggins	January 1952–February 1953
Roger Lewis	April 1953–September 1955
Dudley C. Sharpe	October 1955–January 1959
Philip B. Taylor	April 1959–February 1961

Special Assistants for Research and Development

William A. M. Burden	September 1950–June 1952
Trevor Gardner	February 1953–February 1955

Assistant Secretaries of the Air Force (Research and Development)

Trevor Gardner	March 1955–February 1956
Richard E. Horner	July 1957–May 1959
Joseph V. Charyk	June 1959–January 1960
Courtland D. Perkins	February 1960–January 1961

Commanding Generals, Army Air Forces

General of the Army Henry H. Arnold*	March 1942–February 1946
Gen. Carl A. Spaatz	February 1946–September 1947

*Appointed to permanent rank of General of the Army, 25 March 1946; and General of the Air Force, 7 May 1949.

Deputy Commanders and Chiefs of Air Staff, Army Air Forces

Lt. Gen. Ira C. Eaker	April 1945–August 1947
Lt. Gen. Hoyt S. Vandenberg	August 1947–September 1947

Chiefs of Staff, U. S. Air Force

Gen. Carl A. Spaatz	September 1947–April 1948
Gen. Hoyt S. Vandenberg	April 1948–June 1953
Gen. Nathan F. Twining	June 1953–June 1957
Gen. Thomas D. White	July 1957–June 1961

Vice Chiefs of Staff

Gen. Hoyt S. Vandenberg	October 1947–April 1948
Gen. Muir S. Fairchild	May 1948–March 1950
Gen. Lauris Norstad (Actg)	May 1950–October 1950
Gen. Nathan F. Twining	October 1950–June 1953
Gen. Thomas D. White	June 1953–June 1957
Gen. Curtis E. LeMay	July 1957–June 1961

Assistant Chief of Air Staff, Materiel and Services, Army Air Forces

Maj. Gen. E. M. Powers	April 1945–October 1947

Deputy Chiefs of Staff, Materiel

Lt. Gen. Howard A. Craig	October 1947–September 1949
Lt. Gen. Kenneth B. Wolfe	September 1949–June 1951
Lt. Gen. Orval R. Cook	July 1951–March 1954
Lt. Gen. Bryant L. Boatne	April 1954–April 1955
Lt. Gen. Clarence S. Irvine	April 1955–April 1959
Lt. Gen. Mark E. Bradley	June 1959–June 1961

Deputy Chief of Air Staff, Research and Development, Army Air Forces

Maj. Gen. Curtis E. LeMay	December 1945–October 1947

Deputy Chiefs of Staff, Development

Maj. Gen. Gordon P. Saville	January 1950–May 1951
Maj. Gen. Donald L. Putt (Actg)	June 1951–November 1951
Lt. Gen. Laurence C. Craigie	November 1951–April 1954*
Lt. Gen. Donald L. Putt	April 1954–June 1958
Lt. Gen. Roscoe C. Wilson	July 1958–June 1961

*From October 1953 to June 1955, the Deputy Chief of Staff, Development, reported to the Deputy Chief of Staff, Materiel.

Air Materiel Command (Army Air Forces/U.S. Air Force)

Lt. Gen. Nathan F. Twining	March 1946–October 1947
Gen. Joseph T. McNarney	October 1947–August 1949
Gen. Benjamin W. Chidlaw	September 1949–August 1951
Gen. Edwin W. Rawlings	August 1951–February 1959
Gen. Samuel E. Anderson	March 1959–March 1961

Air Research and Development Command

Maj. Gen. David M. Schlatter	February 1950–June 1951
Lt. Gen. Earle E. Partridge	June 1951–June 1953
Lt. Gen. Donald L. Putt	June 1953–April 1954
Lt. Gen. Thomas S. Power	April 1954–June 1957
Maj. Gen. John W. Sessums, Jr.	July 1957
Lt. Gen. Samuel E. Anderson	August 1957–March 1959
Maj. Gen. John W. Sessums, Jr.	March 1959–April 1959
Lt. Gen. Bernard A. Schriever	April 1959–April 1961

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List of Abbreviations

AA	Anti Aircraft
AAA	Anti Aircraft Artillery
AAF	Army Air Forces
AAV	Assault Amphibious Vehicle
ABMA	Army Ballistic Missile Agency
A/C	Aircraft
ACNO	Assistant Chief of Naval Operations
AE	Applications Engineering
AFCV	Vice Chief of Staff, U.S. Air Force
AFF	Army Field Forces
AFHRA	Air Force Historical Research Agency
AFHSO	Air Force History Support Office
AFPC	Armed Forces Policy Council
AFPR	Air Force Plant Representative
AFR	Air Force Regulation
AIA	Aircraft Industries Association/ Aerospace Industries Association
AMC	Air Materiel Command
ANMB	Army-Navy Munitions Board
AOMC	Army Ordnance Missile Command
APRA	Aircraft Production Resources Agency
AR	Army Regulation
ARADCOM	Army Air Defense Command
ARDC	Air Research and Development Command
ARPA	Advanced Research Projects Agency
ASA	Assistant Secretary of the Army
ASW	Anti Submarine Warfare
BAH	Booz, Allen & Hamilton
BAT	Battalion Antitank Weapon
BDV	Boeing/Douglas/Vega
BIS	Board of Inspection and Survey
BMD	Ballistic Missile Division
BoB	Bureau of the Budget

BuAer	Bureau of Aeronautics
BuDocks	Bureau of Yards and Docks
BuMed	Bureau of Medicine and Surgery
BuOrd	Bureau of Ordnance
BuPers	Bureau of Naval Personnel
BuSandA	Bureau of Supplies and Accounts
BuShips	Bureau of Ships
BuWeps	Bureau of Naval Weapons
Caltech	California Institute of Technology
CEP	Circular Error Probable
CFAE	Contractor Furnished Aeronautical Equipment
CFE	Contractor Furnished Equipment
CINCUSAREUR	Commander-in-Chief, U.S. Army, Europe
CMH	U.S. Army Center of Military History
CNO	Chief of Naval Operations
CO	Commanding Officer
CONARC	Continental Army Command
Convair	Consolidated-Vultee
CSA	Chief of Staff, U.S. Army
CV	Aircraft Carrier
CVA	Heavy Aircraft Carrier (later Attack Aircraft Carrier)
CVB	Aircraft Carrier, Large
D.	Democrat
DCNO	Deputy Chief of Naval Operations
DCS	Deputy Chief of Staff
DCS/D	Deputy Chief of Staff, Development
DCSLOG	Deputy Chief of Staff, Logistics
DCS/M	Deputy Chief of Staff, Materiel
D-Day	Unnamed day on which a particular operation commences or is to commence
DDR&E	Director of Defense Research and Engineering
DoD	Department of Defense
DPA	Defense Production Administration
ERP	European Recovery Program
FABMDS	Field Army Ballistic Missile Defense System
FIRM	Fleet Introduction of Replacement Models
FM	Field Manual
FY	Fiscal Year
GAO	General Accounting Office
GFAE	Government Furnished Aeronautical Equipment
GFE	Government Furnished Equipment
GMC	General Motors Corporation
GOR	General Operational Requirement
GPO	U.S. Government Printing Office
HOI	Headquarters Operating Instruction
HQMC	Headquarters Marine Corps

IBM	International Business Machines
IBTC	Inter-Bureau Technical Committee
ICAF	Industrial College of the Armed Forces
ICBM	Intercontinental Ballistic Missile
ICC	Interstate Commerce Commission
IG	Inspector General
IOC	Initial Operational Capability
IRBM	Intermediate Range Ballistic Missile
JATO	Jet-Assisted Takeoff
JCS	Joint Chiefs of Staff
JRDB	Joint Research and Development Board
LC	Library of Congress
LST	Landing Ship, Tank
LVT	Landing Vehicle, Tracked
MB	Munitions Board
MDAP	Mutual Defense Assistance Program
M-Day	Date on which mobilization is to commence
MIT	Massachusetts Institute of Technology
MRRC	Materiel Requirements Review Committee
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NAVBMC	Navy Ballistic Missile Committee
NDU	National Defense University
NHC	Naval Historical Center
NPA	National Production Authority
NSC	National Security Council
NTDS	Naval Tactical Data System
OAB	Operational Archives Branch, Naval HistoricalCenter
OASD (R&D)	Office of the Assistant Secretary of Defense (Research and Development)
OCRD	Office of the Chief of Research and Development
ODM	Office of Defense Mobilization
ONR	Office of Naval Research
OPNAV	Office of the Chief of Naval Operations
ORO	Operations Research Office
OSD	Office of the Secretary of Defense
OSDBMC	Office of the Secretary of Defense Ballistic Missiles Committee
OSD/HO	Office of the Secretary of Defense, Historical Office
PCR	Program Control Room
PERT	Program Evaluation Review Technique
PPBS	Planning, Programming, and Budgeting System
P&P Div.	Plans and Policy Division
QMC	Quartermaster Corps
R.	Republican

R&D	Research and Development
RDB	Research and Development Board
RDT&E	Research, Development, Test, and Evaluation
RG	Record Group
SAC	Strategic Air Command
SAGE	Semi-Automatic Ground Environment
SecDef	Secretary of Defense
SecNav	Secretary of the Navy
SHAPE	Supreme Headquarters Allied Powers Europe
SINS	Ship Inertial Guidance System
SLBM	Submarine Launched Ballistic Missile
SPO (Air Force)	System Program Office
SPO (Navy)	Special Projects Office
SS&P	Service, Supply & Procurement (Directorate)
SupShips	Supervisor of Shipbuilding
Temco	Texas Engineering and Manufacturing Company
TRW	Thompson-Ramo-Wooldridge
USA	U.S. Army
USAF	U.S. Air Force
USAIRA	U.S. Air Attaché
USAMHI	U.S. Army Military History Institute
U.S.C.	United States Code
USMC	U.S. Marine Corps
USN	U.S. Navy
USO	United Service Organizations
USS	U.S. Ship
VCS	Vice Chief of Staff
V-J Day	Victory over Japan Day
WSEG	Weapons Systems Evaluation Group
WSPO	Weapon System Project Office

Notes on Sources and Selected Bibliography

The major primary sources for this volume are the records of the Office of the Secretary of Defense and those of the U.S. military services—the Army, Navy, Marine Corps, and Air Force. Most are located at the National Archives at College Park, Maryland, usually referred to as Archives II, and are managed by the archivists and technicians assigned to the Modern Military Records Branch of the Textual Archives Services Division. Substantial collections of these documentary materials are also housed at other repositories in the Washington, D.C., metropolitan area and elsewhere throughout the United States.

At Archives II, the records of the Office of the Secretary of Defense are organized in Record Group (RG) 330 and are generally arranged by the offices of the secretary's principal assistants. For the period from 1947 through the end of the Korean War, the records of the Munitions Board and the Research and Development Board were especially important to this study as were those of the assistant secretaries of defense in the years following 1953.

The Records of the Joint Chiefs of Staff (RG 218), also at College Park, were significant to the preparation of this history because the Joint Chiefs made recommendations regarding force levels and composition to the secretary of defense, thereby establishing acquisition parameters for the services. Moreover, JCS records were crucial to understanding the controversy over relative production priorities in late 1951 and early 1952.

Over the years, the historians in the OSD Historical Office have assembled an extraordinarily varied collection of materials pertaining not only to the history of the Office of the Secretary of Defense but to the military departments as well. Among them are reference files organized by subject and year that include newspaper clippings, magazine articles, reports, organization charts, budget tables, press releases, and many other types of sources useful to the historian. The office also houses several key document collections that were vital to this history:

the files of Wilfred J. McNeil, the assistant secretary of defense (comptroller) from the late 1940s through the late 1950s; the papers of Henry E. Glass, an assistant to the secretary of defense and the deputy secretary of defense, that include comptroller documents covering the early 1950s; the annual and semiannual reports of the secretary of defense and the secretaries of the military departments; the public statements of the secretary and deputy secretary; and DoD directives and instructions.

Archives II is the major repository for U.S. Army historical records. For this study the most important were: RG 335 (Records of the Office of the Secretary of the Army), RG 319 (Records of the Army Staff), and RG 156 (Records of the Office of the Chief of Ordnance). Additionally, the Papers of Lt. Gen. LeRoy Lutes, director of the staff of the Munitions Board in 1948 and 1949, are contained in RG 200 (National Archives Gift Collection). The U.S. Army Military History Institute, part of the Army's Heritage and Education Center, and located in Carlisle, Pennsylvania, holds a large variety of the service's historical materials, especially collections of personal papers of senior Army officers. The Institute's file of Army regulations since 1945 was essential in tracing the evolution of Army policy and organization regarding acquisition. The U.S. Army Center of Military History, the author's "home" for several years while this history was being researched and written, has put together a file of biographical material on Army general officers. Its archive also contains some records of Army staff offices such as the Office of the Chief of Research and Development. One of this office's annual reports yielded the Proceedings of the Lead Time Symposium of December 1958. This document formed much of the basis for one of the sections in the chapter on the Army from 1953 through 1960. Finally, at the Evans Library of the Florida Institute of Technology, the extensive but little-used Papers of Maj. Gen. John B. Medaris, who commanded the Army Ballistic Missile Agency (and subsequently the Army Ordnance Missile Command) in the second half of the 1950s, provided numerous documents throwing light on both the Army's missile program and on the service's approach to acquisition.

The records of the Navy's bureaus at Archives II are indispensable for understanding how acquisition worked in that service: RG 19 (Bureau of Ships), RG 72 (Bureau of Aeronautics), and RG 74 (Bureau of Ordnance). Additionally, some key Bureau of Aeronautics records are located in the files of its successor organizations, the Bureau of Naval Weapons (RG 402) and the Naval Air Systems Command (RG 343). Also important, especially for acquisition policy, were RG 428 (General Records of the Department of the Navy) and RG 127 (Records of the United States Marine Corps). The Naval History and Heritage Command (formerly the Naval Historical Center) is the repository for a diverse collection of Navy historical materials. Especially significant for this study were the immediate office files of the Chief of Naval Operations (Op–00); the records accumulated by Booz, Allen & Hamilton, Inc., for the study, *Review of Navy R&D Management, 1946–1973* (1976); and the archives of the Navy Laboratory

Center Coordinating Group, 1940s–1990s, especially the large collection of oral histories it contains. In the Op–00 files, the author drew extensively on the transcripts of the testimony of more than 50 witnesses appearing before the Libby Board in 1956. These documents offer a wide-ranging and often candid glimpse into the Navy's acquisition policy, organization, and processes in the mid-1950s.

Post–World War II Air Force records at College Park are in RG 340 (Office of the Secretary of the Air Force) and RG 341 (Headquarters United States Air Force). The latter are essentially the records of the Air Staff. The papers, actually the office files, of the chiefs of staff of the Air Force for the years 1947–1960—Generals Spaatz, Vandenberg, Twining, and White—and vice chiefs of staff—Vandenberg, Fairchild, Twining, and LeMay—were important to this study and are located in the Manuscript Division of the Library of Congress. Unlike the records of the Army's technical services and the Navy's bureaus, the documentary records of the Air Force's acquisition field commands are not deposited at Archives II. Air Force historians on the staffs of the Air Materiel Command and the Air Research and Development Command selected and appended documents to the annual histories of these commands. They are deposited at the Air Force Historical Research Agency, Maxwell Air Force Base, Alabama. Like the papers of the chiefs and vice chiefs of staff, these materials were valuable sources of information. In addition to the annual histories, the Air Force Historical Research Agency maintains other important records, including the personal papers and oral history interviews of many Air Force figures, both military and civilian, who played key roles in acquisition during these years. Copies of many of the original records filed at the Air Force Historical Research Agency are also available on microfilm at the Air Force History Support Office at Bolling Air Force Base in Washington, D.C. That agency has also assembled its own collection of documentary materials.

Congressional publications, primarily committee hearings and reports, contained considerable information on acquisition, particularly those of both the House and Senate Committees on Appropriations and Armed Services and the House Committee on Government Operations. Especially fruitful were the hearings and reports of the Senate Preparedness Investigating Subcommittee.

Unlike the first Hoover Commission on Organization of the Executive Branch of Government (1949), the second (1955) focused heavily on research and development and procurement. The Office of the Secretary of Defense sought to implement many of the latter commission's recommendations. The reports of both Hoover Commissions are in RG 287 (Publications of the United States Government); their files are in RG 264 (Records of the Commissions on Organization of the Executive Branch of Government) at College Park.

From 1946 on, many of the top officials involved in acquisition in OSD and the services as well as prominent scientists and industrialists lectured at the Industrial College of the Armed Forces at Fort Lesley J. McNair in Washington, D.C. The transcripts of those addresses (including the subsequent question and answer sessions)—numbering in the hundreds—are maintained at the National Defense University's Marshall Library at Fort McNair and are also available on the National Defense University's website. They cover nearly every aspect of acquisition and proved to be unique and invaluable source materials for this history.

Although most key acquisition officials had died when research for this study began, many had been interviewed before their deaths and their recollections often provided important insights. These oral histories are preserved at numerous locations, including the Air Force Historical Research Agency, the Air Force History Support Office, Columbia University, the Dwight D. Eisenhower and Harry S. Truman presidential libraries, the Historical Office of the Office of the Secretary of Defense, the Naval Historical Center (notably the archives of the Navy Laboratory Center Coordinating Group, 1940s–1990s), the U.S. Army Center of Military History, the U.S. Army Military History Institute, and the U.S. Naval Institute in Annapolis, Maryland. The Defense Acquisition History Project conducted a significant number of interviews. For this volume, the recollections of Frederic M. Scherer were especially informative as were the materials prepared by the Weapons Acquisition Research Project team of the Harvard University's Graduate School of Business Administration in the late 1950s and early 1960s that he made available to the Defense Acquisition History Project. As is true with an increasing number of historical materials, many of these oral history interviews are available on the internet.

In addition to archival sources, the author benefited from several published documentary collections: the official multivolume series of the *Public Papers of the Presidents* for both the Truman and Eisenhower administrations; the *Papers of Dwight David Eisenhower*, edited first by Alfred D. Chandler, Jr., and later by Louis Galambos; and the OSD Historical Office's *The Department of Defense: Documents on Establishment and Organization*, edited by Alice C. Cole, Alfred Goldberg, Samuel A. Tucker, and Rudolph Winnacker.

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