Acquisition Management
in the United States Air Force and its Predecessors

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Air Force History and Museums Program
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FOREWORD

In its first fifty years as an independent armed service, the United States Air Force (USAF) has fostered science and technology and—in partnership with the private sector—developed and produced the complex tools of aerospace power that helped the Free World prevail in the Cold War. The foundation for these extraordinary achievements was laid in the forty years before the Air Force separated from the U.S. Army in 1947. This booklet tells the story of how the air components of the Army and then the USAF organized and managed the activities required to get aircraft and other weapon systems from the drawing board to the flightline or the launch pad.

Published as one of a series of booklets celebrating the 50th anniversary of the USAF in 1997, this study is the first overall historical synopsis of the service's acquisition structure. The text was originally prepared as a chapter in the *Air Force Acquisition Factbook*, a compendium of acquisition programs and policies published by the Office of the Assistant Secretary of the Air Force (Acquisition). Hence the study is intended both to educate personnel in today's acquisition community about their antecedents and to commemorate this aspect of the Air Force's heritage to a wider audience.

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Acquisition Management

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Overview

During the Twentieth Century the United States became the world's premier aerospace nation, both commercially and militarily. Inventing, developing, testing, evaluating, buying, and producing the implements of air power grew into an enterprise of unprecedented complexity. Leading this effort, the United States Air Force evolved from a small division of the Army's Signal Corps into one of the nation's largest purveyors of technology. As it did so, the Air Force frequently revised its organizational structure to manage these tasks—now referred to collectively as the acquisition process. Although the historical circumstances and the state of technology changed greatly as the century progressed, some recurring patterns of organization emerged.

Before World War II, when the manufacturing of American military airplanes was a low-volume, handwork-type industry, the U.S. Army concentrated almost all air acquisition management activities at one organization in the vicinity of Dayton, Ohio (the birthplace of aviation). Also included within this organization—designated in 1926 as the Air Corps' Materiel Division—were the logistics functions of supply, maintenance, support equipment, and industrial planning. Although some key procurement decisions were made in Washington, D.C., the Materiel Division played a critical role in fostering the development of American aviation technology during

the interwar period. In many areas, however, this technology lagged behind that of other industrial nations.

The vast expansion of the Army Air Forces during World War II led to a split between the functions of research and development (R&D) and those of materiel and support. This was accompanied by some dispersal of procurement authority (i.e., purchasing and contract management). As the Army Air Forces demobilized after victory over Japan, it once again centralized development, procurement, and logistics into the Air Materiel Command. Before long, however, the crucible of the Cold War and its arms race led the young U.S. Air Force in 1950 to assign R&D to a new Air Research and Development Command. Then in 1961—after a decade of growing experience with managing weapons as comprehensive systems—the Air Force realigned acquisition with research, development, test, and evaluation (RDT&E) to create the Air Force Systems Command. At the same time, the remaining functions of Air Materiel Command were retained in a new Air Force Logistics Command.

In the late 1980s, demands for a more streamlined acquisition process led the Air Force to centralize management for major systems in the Pentagon under a new Assistant Secretary of the Air Force for Acquisition. With the end of the Cold War, the U.S. defense industry began to consolidate into fewer companies and return to low-volume production reminiscent of the 1930s (albeit with high technology products). For its part, the Air Force in 1992 reinstated a single command to handle RDT&E, small acquisition programs, and logistics. Located once more near Dayton, Ohio, at Wright-Patterson Air Force Base (AFB), the Air Force Materiel Command carries on a long tradition into a new and uncertain era.

The essay that follows summarizes how the Air Force and its predecessors organized the process of acquiring the aircraft and other systems to help fight the nation's armed conflicts and ultimately prevail in the Cold War. Acquisition management is a subject of exceeding complexity, especially in the context of related areas such as military doctrine, operational requirements, defense strategy, industrial preparedness, and policies fostering

science and technology. As prefaced in the definitive study of aircraft acquisition in World War II, "one cannot truly understand...air power without first coming to appreciate something of the enormous complexity of procurement."[1] A comprehensive analysis of acquisition is well beyond the scope of this essay. It is intended merely to acquaint readers with the evolving organizational framework used by the Air Force to acquire the tools of aerospace power.

From the Great War through the Great Depression, 1914–1939

Although Orville and Wilbur Wright sold the first military airplane to the U.S. Army Signal Corps in 1909, the United States soon fell behind the European powers in aircraft design and production—especially after the outbreak of World War I in 1914. Recognizing the nation's lag in aviation technology, Congress created the interagency National Advisory Committee for Aeronautics (NACA) in March 1915. But until the long-delayed completion of its experimental center at Langley Field, Virginia, in 1920, NACA was unable to contribute directly to aircraft development. For advancing military technology in general, the National Academy of Sciences convinced a reluctant President Woodrow Wilson to endorse the formation of the National Research Council in April 1916 to help mobilize American scientific resources in support of national preparedness. Funding and administrative restrictions, as well as the military leadership's lack of appreciation for the potential of new technologies, limited the benefits of this umbrella organization.

After the United States declared war on 6 April 1917, NACA took the lead in drawing up a plan for aircraft production. The War Department disregarded NACA's plan in favor of a more ambitious one of its own. Not even an expensive, crash program by an energized government-industry partnership could make this rash plan into a reality. The effort came under the aegis of the Aircraft Production Board—created on 12 April 1917 as an element of the recently formed National Defense Council to coordinate aircraft manufacturing for both the Army and Navy. The Army's internal organization also proved inadequate for managing its air mission, and on 20 May 1918, President Wilson elevated Army aviation from the Signal Corps to the War Department. Three days earlier, the President had established within the Army a Bureau of Aircraft Production, responsible for what would today be considered acquisition management. The War Department had already created the Division of Military Aeronautics, responsible for operations and training. On 24 May 1918 both organizations became components of the newly created Air Service. The Air Service, however, was not

placed under a single leader until John D. Ryan, head of the Bureau of Aircraft Production, was also named Director of the Air Service on 28 August 1918.

The Air Service progressively consolidated its acquisition-related functions near the home of the Wright Brothers. The Bureau of Aircraft Production included an Engineering Production Department located at McCook Field, founded in 1917 just outside Dayton, Ohio, and an Airplane Experimental Department in Washington, D.C. These two overlapping departments, frequently at odds with each other, were later combined with the Bureau's Science and Research Department and Technical Information Department to create a new Engineering and Research Division. On 13 September 1918 this element was reorganized as the Engineering Division of the Air Service and consolidated at McCook Field. Five days later, the Bureau of Aircraft Production ordered the Armament Section of its Ordnance Department to also move to McCook Field so its technicians could work directly with the aircraft engineers.

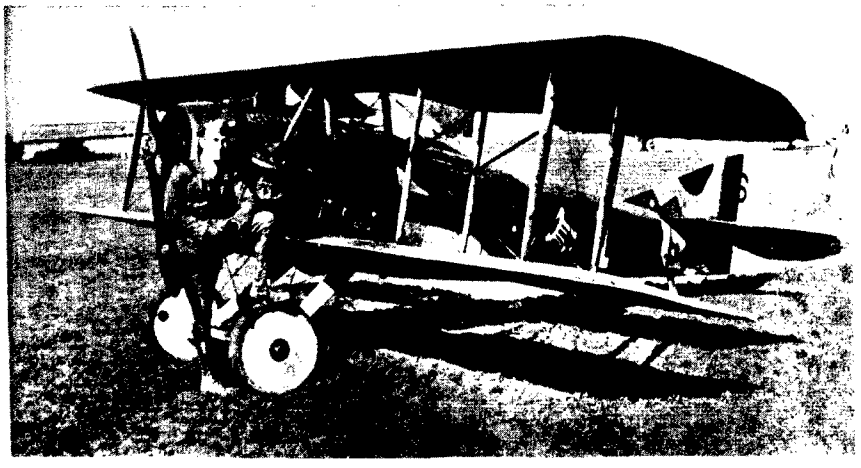
The war ended too soon for these reorganizations and other management changes to have much beneficial effect. Because of mismanagement, distance from the theater of operations, and technical obstacles, the United States did not develop effective combat aircraft. As a result, its pilots in Europe flew mostly in French and British machines. American industry was able to supply the Army with approximately 12,000 aircraft (mostly trainers and observation aircraft). The Allies sold the United States approximately 5,200 aircraft (including almost all its pursuit models). The Air Service's major acquisition success story of World War I was mass production of the Liberty engine, thanks in part to the existing capabilities of the automobile industry. But aircraft themselves proved much more complicated to produce than autos. And the use of contracts negotiated to reimburse private companies for their costs plus an additional percentage of these costs encouraged private companies to enter the risky new aviation industry but proved a disincentive for improving efficiency.

Despite the accelerating contributions of aviation to the war, the Army failed to recognize the potential significance of air power or apply the lessons learned in combat. "But even doctrine is inadequate," observed a noted airpower historian, "without an organization to administer the tasks involved in se-

lecting, testing, and evaluating inventions. The history of weapons in the United States is filled with evidence on this point."[2]

With the postwar demobilization, the Air Service abruptly terminated most acquisition programs, leading to financial chaos in the fledgling aircraft industry and thousands of court claims against the Government. For the future, Congress mandated fixed-price contracts because of its perception that the cost-plus contracts used during the war had led to excess profiteering. In the immediate postwar period, the Air Service focused much of its attention on managing the surplus of supplies and equipment inherited from the war. In 1919 its residual aircraft development resources were further concentrated at McCook Field. Here the Engineering Division added the Technical Section of the Division of Military Aeronautics, a testing squadron at nearby Wilbur Wright Field, and aircraft experimental activities from Langley Field. The Supply Division in Washington exercised procurement responsibility for the Air Service; however, as formalized by the National Defense Act of 1920, the Office of the Assistant Secretary of War was tasked with industrial planning for the Army. Formation of the Army-Navy Munitions Board helped assure some degree of inter-service coordination in acquiring weapons.

Despite the postwar drawdown, the Materiel Division—under the command of Col. Thurman H. Bane—developed some



Like top-ace Eddie Rickenbacker, shown here with his French Spad 13, all American combat pilots in the Great War had to fly Allied aircraft.

significant technical innovations as it began to evolve into an arsenal-type organization. The Division even built some new aircraft models. After 1923, however, money for such experiments became even scarcer. In recognition of the need to maintain an industrial base of private aircraft companies, Chief of the Air Service Maj. Gen. Mason Patrick in 1925 restricted the Engineering Division's design activities and prohibited it from building experimental aircraft.

The U.S. Army Air Corps, which replaced the Air Service on 2 July 1926, united the Engineering Division with the Field Service Section at nearby Wilbur Wright Field to form the Materiel Division on 15 October 1926. The new division, which moved to Wright Field* when McCook Field closed in 1927, was responsible for the Air Corps' acquisition functions. It included the following six sections: (1) War Plans (responsible for industrial mobilization), (2) Experimental Engineering (research, development and testing), (3) Field Service (depot management), (4) Repair and Maintenance, (5) Inspection, and (6) and Procurement (later Contracting), which had previously been controlled from Washington, D.C., by the Air Service's Supply Division. Delegated great authority for all these functions, the Materiel Division was represented in Washington by a liaison office. It thereby practiced a form of "cradle to grave" management, although some of its authority began to migrate back to the Office of the Chief of the Air Corps in Washington in the late 1930s.

Despite some interesting work in its laboratories, the Materiel Division's R&D activities focused primarily on applied research. Most fundamental (i.e., basic) research during the interwar years was, by law, the province of NACA and the National Bureau of Standards. With its limited resources, the Materiel Division initially concentrated on maintaining and upgrading the Air Service's inventory of fewer than 1,000 serviceable aircraft and related equipment.

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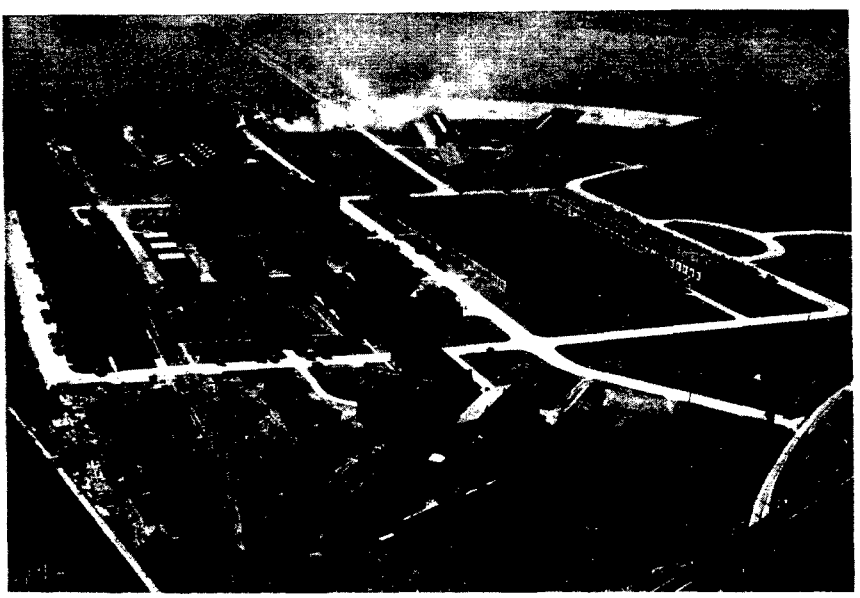
*To keep the Engineering Division in Dayton, as McCook Field became too small, a group of local businessmen in 1924 purchased and donated to the Air Service an area that encompassed Wilbur Wright Field, Huffman Prairie, and the Fairfield Supply Depot. The installation, which opened in 1927, was renamed Wright Field in honor of both Orville and Wilbur. In 1931 the eastern portion was designated Patterson Field in honor of the leader of the purchase campaign's son, who had died testing a DH–4 there during World War I.

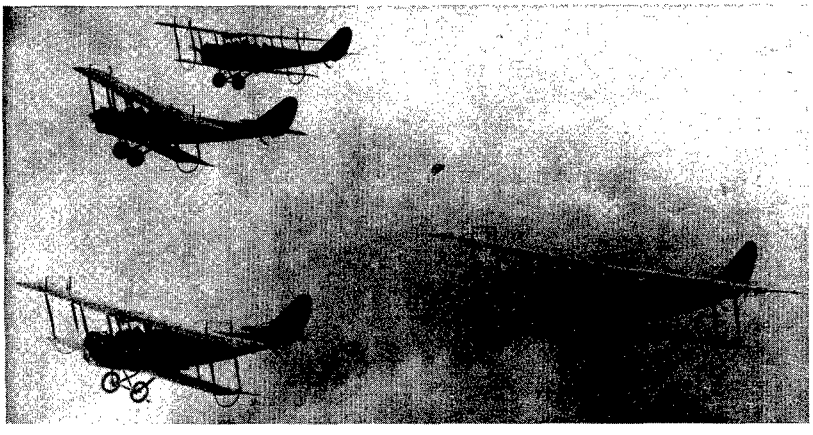
Col. Thurman H. Bane, Commander of the Engineering Division after World War I, established the foundation for the future technology complex at Wright-Patterson AFB, Ohio.



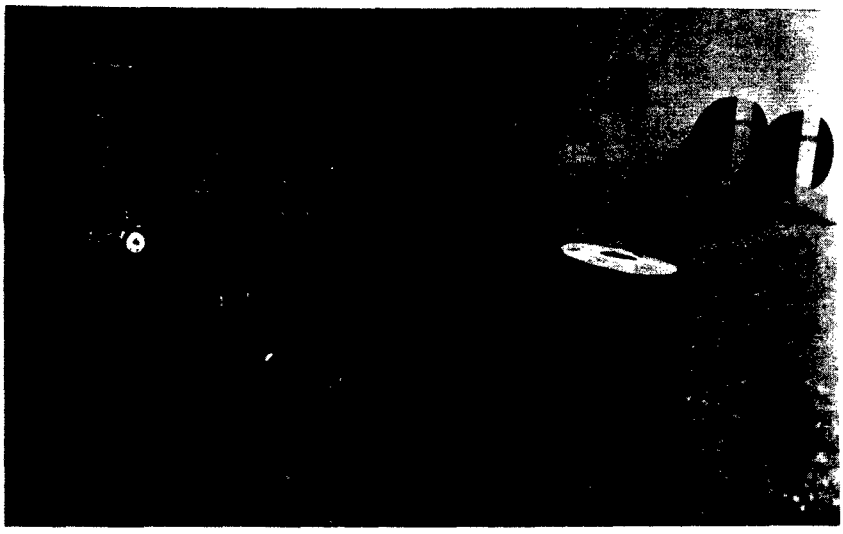
The Materiel Division at Wright Field in the early 1930s.

Examples of Aircraft Procurement by the Air Service and Air Corps

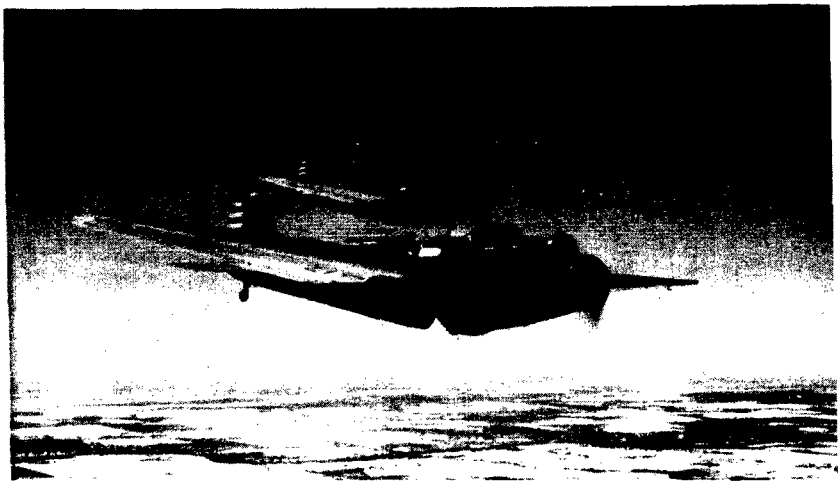
Liberty V-12 aircraft engines being produced by the Dayton-Wright Airplane Company in July 1918. (Note that women worked in the aviation industry during World War I as well as World War II.)



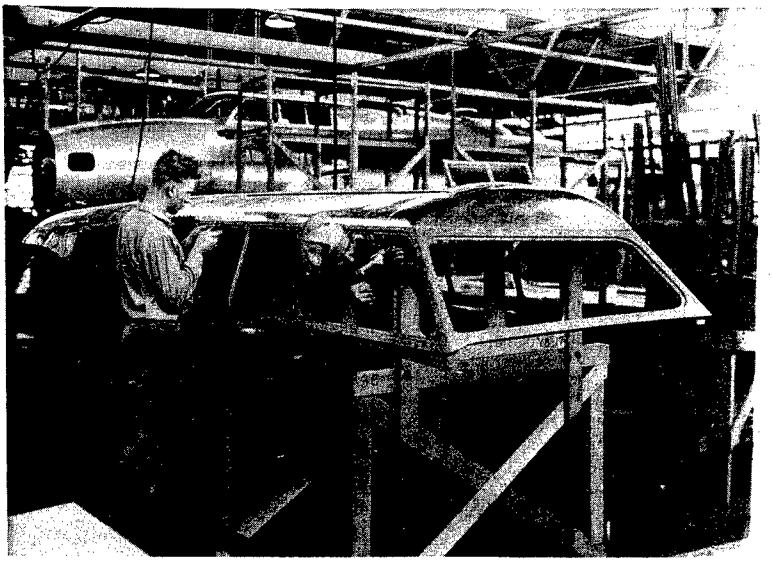
Curtiss JN-4 "Jenny" trainers, which the American aircraft industry was able to produce in quantity during World War I.



Martin MB–2 Bomber, one of 50 built by Curtiss Aircraft as part of an Air Service program to divide orders among different manufacturers during the postwar recession in the aircraft industry.



The all-metal Martin B–10 was the world's most advanced bomber when first delivered in 1934 but became obsolete in only a few years.



As illustrated by the fabrication of this YB–17 cockpit, hand crafting rather than mass production characterized the aircraft industry before World War II.

The legislation which created the Air Corps and earlier laws enacted after World War I ordained a process of circulars and sealed bids that were designed to encourage impartial competition among numerous small airplane companies existing in the early 1920s. In 1926 Congress also authorized a special five-year aircraft procurement program, and after a one-year delay, the Air Service embarked on a modest expansion in the late 1920s. The Great Depression, however, dried up appropriations for the program in the early 1930s, and with commercial contracts scarce as well, only relatively small number of the hardiest manufactures survived.

Yet this was a time of great aeronautical progress when even the latest models rapidly grew obsolete in the face of advances such as streamlined all-metal monocoque fuselages, retractable landing gear, turbocharged engines, variable pitch propellers, and increasingly reliable navigation gear. As reflected by the disastrous attempt to take over air mail operations in 1934, the Air Corps in many ways had fallen technologically behind commercial aviation (not to mention the rapidly expanding air power of Nazi Germany and Imperial Japan). "At best, the progression from idea to aircraft was a difficult journey."[3] Numer-

ous barriers stood in the way. Provisions in the laws enacted after World War I to foster competition and prevent profiteering resulted in rigid and inflexible procurement practices unsuited to the realities of the aviation industry. The political forces of isolationism and widespread distrust of "the merchants of death" (i.e., the armaments companies), as well as Congressional frugality and Air Corps timidity, precluded an efficient relationship with private industry and an effective buildup of air power.

The acquisition process remained slow and deliberate. So-called "design competitions" yielded unrealistic paper proposals from inexperienced businesses. Meanwhile, the prospects of only short-term fixed-price production contracts awarded to the low-bidder in sealed-bid competitions deterred the more capable aircraft manufactures from risking loss of capital or even bankruptcy to develop advanced aircraft. To obtain limited numbers of new aircraft, the Materiel Division relied heavily on small purchases of experimental aircraft, which it then ran through exhaustive tests. Although seldom leading to production in quantity, these contracts and other arrangements helped maintain a residual capacity for producing military aircraft. The Navy's Bureaus of Aeronautics and Ordnance also helped advance aviation technology with projects that sometimes complemented and sometimes competed with those of the Air Corps. In late 1938 the War Department began to reform Air Corps acquisition procedures to provide more incentives for aircraft manufactures to develop new aircraft. But this promising concept was soon overtaken by world events.

Consistent with Air Corps doctrine, a large share of its limited funds in the late 1930s went toward bombers, such as the four–engine B–17 Flying Fortress, at the expense of advanced pursuit aircraft comparable to those being produced in Europe. Other available funds went toward observation aircraft, soon proven an outmoded type. Nevertheless, a few competitive American fighters, such as the P–38 Lightning and P–39 Airacobra, were being developed, and others began to enter design and experimental stages. These would be ready for large-scale production after the war began. Successful commercial aircraft, such as the DC–3, would be easily adaptable for military use as cargo and troop carriers to support a truly global conflict.

Meanwhile, British and French aircraft orders began to prime the pump of the American aircraft industry.

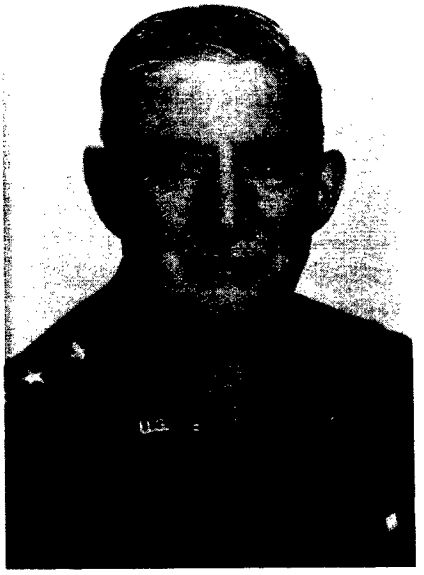
The Arsenal of Democracy, 1939–1945

The United States during World War II became an industrial giant of unprecedented proportions. When President Franklin Roosevelt, in May 1940, boldly called for production of 50,000 aircraft per year, even the Air Corps was taken aback. In the next five years, after having mobilized its industrial resources for total war, the United States produced more than 300,000 military aircraft. Three quarters of these were acquired by the U.S. Army Air Forces (AAF), which was established on 20 June 1941. The Chief of the AAF, General Henry H. "Hap" Arnold, devoted much of his attention to the daunting challenge of building the greatest air armada of all time. Adapting assembly line procedures to the mass production of aircraft, the small aviation companies of the 1930s grew into major corporations. At the same time, the already mature automotive companies retooled to produce engines and some aircraft as well as legions of trucks and tanks.* At its peak in 1943, the American aircraft industry employed more than 2.1 million men and women.

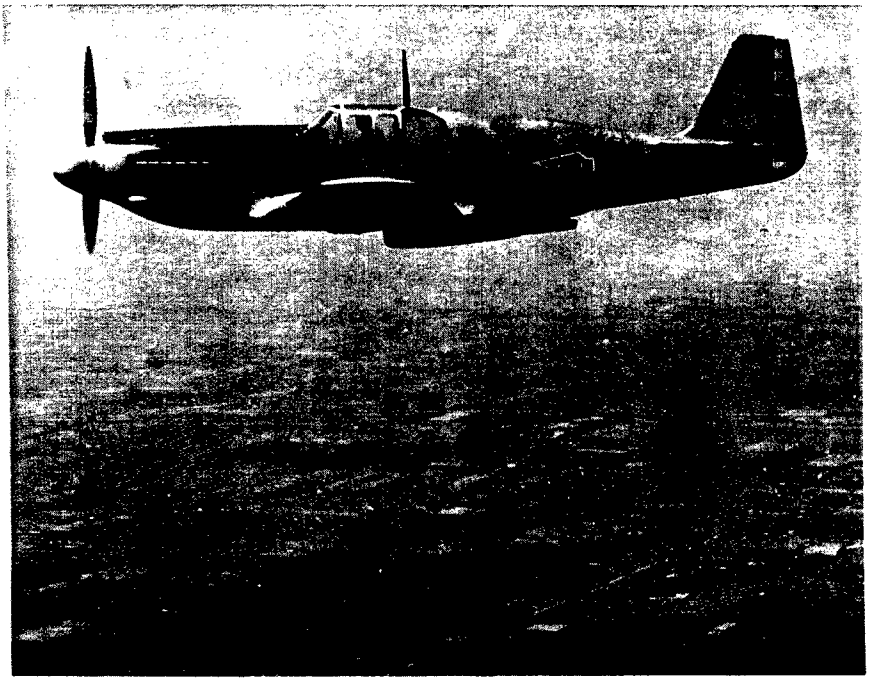
The AAF was part of a national structure for weapons development and procurement which also included Great Britain. At the top, the War Production Board, created in January 1942 helped mobilize and allocate industrial resources.† Under this powerful body, which included an Aircraft Production Board, was the Joint Aircraft Committee. Comprised of British, U.S. Navy, and AAF officials (including General Arnold), this committee decided overall aircraft production priorities as well as ruling on standardization questions. As before the war, NACA continued to serve as the "silent partner" of U.S. air power with its research projects and technical expertise. Another high-level

*The largest aircraft manufacturers of World War II were (in order of numbers produced) North American, Consolidated, Douglas, Curtiss, Boeing, Lockheed, Grumman, Republic, Eastern, Bell, Martin, Chance-Vought, Beech, Ford, Fairchild, Cessna, Piper, and Goodyear—all of which had been in the aircraft business before the war.

†The War Production Board superceded the Office of Production Management, which the President in January 1941 superimposed on a National Defense Advisory Commission he had appointed in May 1940.

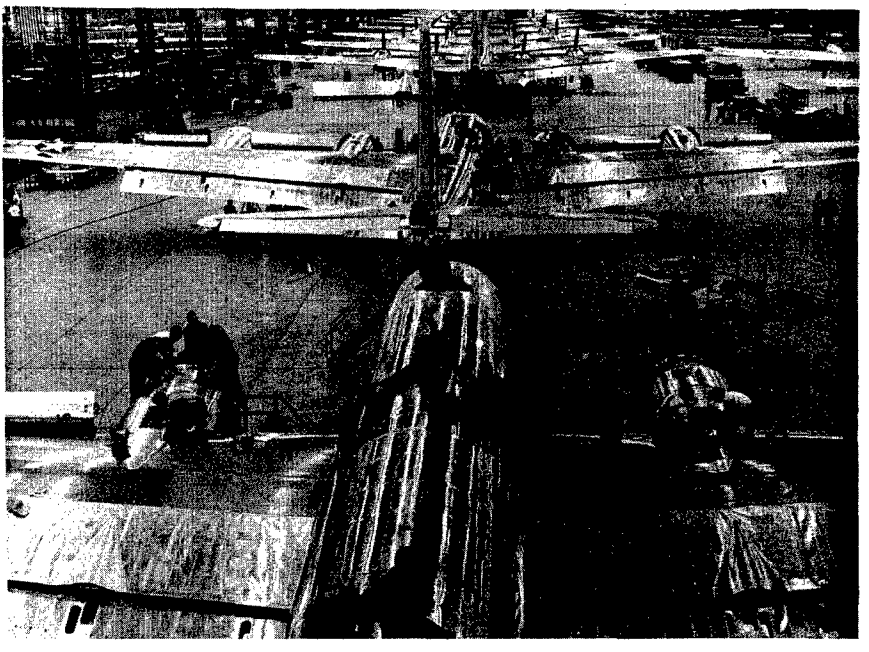


Lt. Gen. William S. Knudsen, formerly President of General Motors Corp., who became Director of Production in the War Department in 1942 and served as the Director of the Air Technical Service Command during 1944 and 1945.



The North American XP-51, developed originally for the Royal Air Force, evolved into the most capable propeller-driven fighter of the war.

When he took charge of the B–29 project, Brig. Gen. Kenneth B. Wolfe became the first manager to be responsible for all aspects of an aircraft acquisition program.



Producing the Boeing B–29 Superfortress—the most complex aircraft of World War II—presented unprecedented technical and management challenges.

government body, the National Defense Research Committee of the Office of Scientific Research and Development (successor to the National Research Council of World War I), worked directly with private industry and universities on many key non-aeronautical projects of direct benefit to the AAF.

Internally, the Air Corps and then the AAF frequently reorganized to deal with their explosive growth from a close-knit element of the small pre-war Army into the largest aerial force of all time. With the outbreak of World War II in Europe, the Air Corps moved the position of Chief of the Materiel Division to Washington on 2 October 1939, with an assistant supervising activities at Wright Field. The Air Corps began expanding rapidly, and the Materiel Division was superseded by two new commands.

To manage logistics functions, the Air Corps Maintenance Command was formed on 29 April 1941 at Patterson Field, located adjacent to Wright Field. This command, originally built from the Materiel Division's Field Service Section, was replaced on 17 October 1941 by the Air Service Command. In December 1941 it came directly under General Arnold. For exactly one year, until 15 December 1942, the command's headquarters were located in Washington, D.C., but thereafter returned to Patterson Field.

To manage its procurement and related RDT&E functions, the AAF made two changes on 16 March 1942. It redesignated the growing office of the Chief of the Materiel Division in Washington as the Materiel Command, while redesignating subordinate elements at Wright Field as the Materiel Center. On 1 April 1943 Headquarters Materiel Command moved back to Wright Field to be near the headquarters of the Air Service Command, but it left behind the former commander and much of his staff as the Assistant Chief of Air Staff for Materiel, Maintenance, and Distribution.

The split between acquisition and logistics caused confusion and duplication. So, on 17 July 1944, the AAF merged the two commands into the AAF Air Technical Service Command, headquartered at Patterson Field.* Once again the management of materiel functions were together, but on a much

*Wright and Patterson Fields were administratively merged in 1945 and named Wright-Patterson Air Force Base (AFB) in 1948.

greater scale than in 1939. Significantly, Lt. Gen. William S. Knudsen, formerly president of General Motors (who had served on the National Defense Advisory Commission and directed the Office of War Production), took charge of the new command. To emphasize its business orientation, he used the title of director rather than commanding general.

Much authority over acquisition matters remained in Washington. In addition to the close attention devoted to aircraft production by General Arnold, Under Secretary for War Robert P. Patterson was legally vested with overall procurement responsibilities for the Army. As the war went on, however, he progressively delegated much of this authority to field commands and their subordinate elements, retaining approval authority only for contracts over $5 million. Robert A. Lovett, appointed in early 1941 to fill the long vacant position of Assistant Secretary of War for Air, had no statutory procurement responsibilities, but he played an active role in handling aircraft production issues within the War Department.

Under its evolving organizational structure and benefiting from the work of outside agencies, the AAF tried to devise streamlined acquisition practices to deal with speed and scope of wartime aircraft development and production. Despite commissioning many officers with business experience in civilian life, the AAF remained short of knowledgeable contracting and engineering officers. Hiring and keeping experienced civil servants in competition with the higher salaries being offered by private industry was also a continuing challenge.

With the large bureaucracy necessitated by the scope of the aircraft procurement effort, finding a compromise between the need for centralized control and coordination and the advantages of decentralized execution proved exceedingly difficult. Attempts to reach out to small businesses scattered across the country also encountered many hurdles and contributed to production delays. Yet despite administrative complications and mountains of paperwork, the Materiel and Air Technical Service Commands eventually were able to achieve timely delivery of planes and equipment.

Flexible contracting practices and allowing the aircraft companies themselves to perform accelerated RDT&E activities no doubt helped expedite the acquisition process. In some cases, the government entered into full-scale production contracts for

aircraft still on the drawing board. Provisions for negotiated cost-plus fixed fee contracts, advance payments, contract amendments, and construction of government-owned/contractor-operated facilities—all of which were authorized by legislation in mid–1940 and the War Powers Act of 1941—afforded the required latitude and incentives.* Peacetime thrift and oversight were set aside to meet the needs for expansion. Until the summer of 1944, AAF policy also called for freezing and standardizing designs to keep assembly lines running smoothly, not for incorporating changes to correct deficiencies or improve performance of aircraft during production.

The emphasis on standardization and quantity over quality greatly expedited production and simplified logistics, but it had some less advantageous consequences when aircraft reached the field. The need for modifications to correct design flaws and improve effectiveness caused many problems. Others resulted from the fact that airframes and their major components were developed and produced separately, not as a total package.† The various Army corps and technical services (e.g., Quartermaster, Ordnance, Chemical) were responsible for providing supplies, consumables, general purpose vehicles, and support equipment, as well as aircraft weapons and subsystems. These included armaments, munitions, and (until the last year of the war, when part of the Signal Corps was absorbed by the AAF) communications and radar. Integration of these components into increasingly sophisticated aircraft left much to be desired. Operational suitability tests by the Air Proving Ground Command (formed at Eglin Field, Florida, in April 1942) revealed many of the design and integration problems, but mainly after production. The AAF relied on its depots, a network of special modification centers, and even units in the field to make the extensive post-production modifications needed to improve performance and reliability. Only toward the end of the war did

*Unlike the cost plus percentage contracts of World War I, the fixed fee, set at a maximum of seven percent, encouraged efficiency while still offering an adequate profit margin.

†The B–29 Superfortress—the most complex aircraft produced during the war—became the first major aircraft to be managed in many ways as a comprehensive weapons system.

the "block" system of incorporating modifications to aircraft on production lines become standard practice.

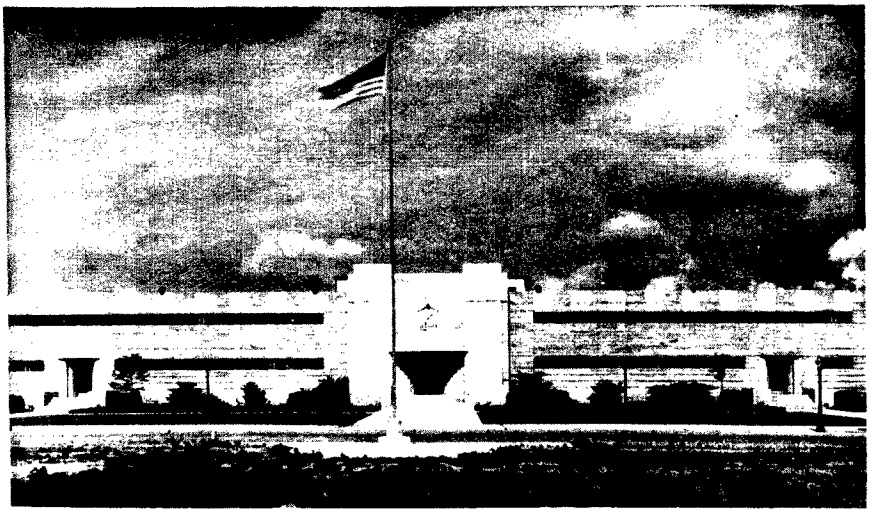
Postwar Demobilization and Deliberations, 1945–1950

Following the unconditional surrender of Japan in September 1945, the war-weary United States began another great demobilization. From wartime peaks of 2.5 million personnel and 80,000 aircraft, the AAF shrank to 730,000 personnel and 30,000 aircraft (many inactive) by mid–1947. The much reduced AAF continued, in some ways, the acquisition system of the pre-war era. The Air Technical Service Command, which became the Air Materiel Command (AMC) on 9 March 1946, remained the single manager of development, testing, procurement, and logistics.

After the United States Air Force (USAF) achieved its independence on 18 September 1947, the first Secretary of the Air Force, W. Stuart Symington, in consultation with the Commander of AMC, Lt. Gen. Nathan F. Twining, centralized the command's organization to perform three pair of core functions: (1) research and development, (2) supply and maintenance, and (3) procurement and industrial planning. With some exceptions, however, AMC devoted more attention to maintaining and improving the most valuable assets inherited from World War II rather than to developing a new generation of aircraft or guided missiles. The combination of functions were reflected on the new Air Staff at the Pentagon, where the Deputy Chief of Staff (DCS) for Materiel oversaw everything from research and development to maintenance and supply.

Although acknowledging the engineering and production miracles of World War II, some Air Force leaders and independent experts were concerned by the AAF's relatively modest record in achieving scientific and technical breakthroughs. Britain and Germany had deployed such revolutionary airpower innovations as radar, jet engines, swept wings, rockets, cruise missiles, and ballistic missiles. Even the AAF's famous Norden bombsight had been developed by the Navy. The greatest scientific achievement of the war—the Atom Bomb—would have been impossible without the contributions of European physi-

Maj. Gen. Donald L. Putt was an influential proponent of a separate command for Research and Development.



Air Materiel Command Headquarters at Wright Field after World War II.

cists. In many areas of research, the practical tradition of American science had been found wanting compared to the more theoretical heritage of European science. With the end of the war, however, the National Defense Research Council was disbanded and research contracts with private industry canceled. The services themselves had to assume more R&D responsibilities. For its part, the AAF began to use universities for basic research.

Air Materiel Command actively expanded its RDT&E mission in the late 1940s—exploiting equipment, records, and experts captured from Germany and leveraging limited funds to work with private industry in developing many promising new technologies. As a general rule, the new U.S. Air Force relied more on contracting for R&D services than using its own personnel to the degree of the Navy or Army. In part, this reflected the Air Force's lack of existing in-house expertise comparable to that in the technical branches, arsenals, shipyards, and major laboratories of the other services.

AMC did achieve some notable successes in its R&D mission—witness Capt. Chuck Yeager's X–1 breaking the sound barrier in 1947. There was, however, a growing body of opinion that the command's focus on the practical matters of logistics management and building a supply system independent of the Army left AMC unsuited to address the Air Force's pressing need to harness science and technology for the future. Dr. Theodore von Karman and his AAF Scientific Advisory Group, under the sponsorship of General Arnold, had highlighted this need in their wide-ranging and influential multi-volume report, *Toward New Horizons*, released in 1945. The creation in June 1946 of the Scientific Advisory Board (which Dr. von Karman chaired from 1948 through 1955) helped institutionalize a constituency for R&D. This was further strengthened with the creation in 1948 of the nonprofit Rand Corporation (from an element of Douglas Aircraft formed three years earlier).

Maj. Gen. Donald L. Putt, as Deputy Chief of AMC's Engineering Division and later as Director of R&D under the Air Force DCS/Materiel, laid much of the groundwork for a separate R&D command. He astutely identified the enduring dichotomy between "technology-push" and "requirements-pull" in the acquisition process when he observed "there are those in high positions in the Air Force today who hold that research and de-

velopment must be kept under rigid control by 'requirements' and 'military characteristics' promulgated by operational personnel who can only look into the past and ask for bigger and better weapons of World War II vintage."[4] In 1949 Gen. Hoyt S. Vandenberg, CSAF, at the urging of the universally respected James H. (Jimmy) Doolittle (Lt. Gen., USAF-Retired),* appointed a special committee of the Scientific Advisory Board headed by Dr. Louis N. Ridenour. This group recommended the Air Force establish a new Research and Development command and approach R&D on a system basis, a viewpoint generally endorsed by another committee headed by Maj. Gen. Orvil Anderson at the Air University.

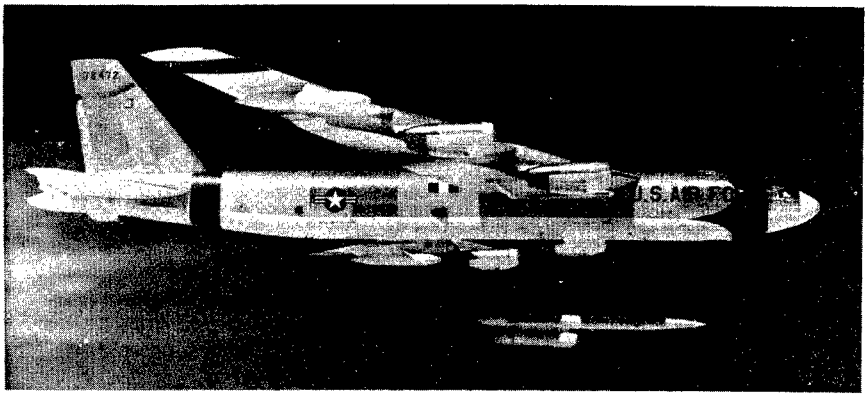
Separate R&D and Procurement Commands, 1950–1961

On 23 January 1950, after the long and sometimes heated debate, the Air Force created the Research and Development Command, with its headquarters initially at Wright-Patterson AFB. It was constructed (after some foot dragging) from Air Materiel Command's RDT&E elements and facilities. Renamed the Air Research and Development Command (ARDC) on 16 September 1950, the new command moved its headquarters to Baltimore, Maryland, in June 1951. Coinciding with the creation of ARDC, the Air Staff established a new DCS for Development, with directorates for R&D and Requirements. AMC, which had been delegated contracting authority from the Secretary of the Air Force in 1950, retained responsibilities for procurement and logistics at its headquarters at Wright-Patterson.

As ARDC matured, the DCS/Development delegated much decision-making authority to the new command, but remained its main point of contact on the Air Staff. By 1953 the Office of the Secretary of the Air Force's increasing involvement in the

*Before becoming a war hero, combat leader, and private sector executive, Doolittle had achieved several aviation milestones as an engineer and test pilot at McCook and Wright Fields from 1918 to 1928, while earning the first doctorate in aeronautical engineering awarded in the United States.

Laurence C. Craigie, godfather of the weapon system concept, as a major general.



The Boeing B–52 represented the first truly successful application of the weapon system concept.

R&D mission was recognized by establishing a Special Assistant for Research and Development as part of the Secretariat. The Office of the Secretary of Defense also expanded its R&D role in June 1953 by creating the Assistant Secretary of Defense for Research and Engineering, whose office absorbed the functions of the National Research and Development Board.

Meanwhile, Soviet progress in developing atomic weapons, the Communist invasion of South Korea, and the unabated threat to Western Europe intensified the Cold War and accelerated an "arms race" between the two superpowers. As a result, the Air Force's RDT&E budget grew rapidly, and with it, the workload and size of ARDC. Much of its activities took place quietly in laboratories, both its own and those of universities and private companies. The most tangible evidence of ARDC's developmental activities included many of the X-series of experimental aircraft, the "century" series of supersonic jet fighters, strategic bombers, and a growing inventory of guided missiles.* At first the Air Force as an institution was slow to acknowledge the revolutionary potential of ballistic missiles, but by the mid-1950s, a new generation of more technologically astute officers began rising to leadership positions.

The increasingly complex and multifaceted nature of developing aircraft and missiles engendered the concept of a "weapons system" encompassing a vehicle with its related airborne and ground equipment, services, facilities, and trained personnel required for it to operate as an instrument of combat. Associated with this concept was the goal of beginning production of the airframe and its components as early as possible despite their increasing sophistication and inter-relatedness. Lieutenant Generals Laurence C. Craigie (a long-time advocate of science and technology†) and Orval R. Cook formalized this in 1953 when they were the Air Force's DCS/Development and DCS/Materiel respectively. Endorsed by a study group, it became known as the "Cook-Craigie plan." The concept of weap-

*Some of the most successful aircraft of the 1950s, however, were initiated as private or largely private ventures. These included the C–130, KC–135, T–38, and U–2.

†As Chief of the Materiel Center's Experimental Aircraft Section, Col. Laurence "Bill" Craigie had become America's first military jet pilot in the XP–59A at Muroc Field, California, on 2 October 1942.

ons system management was not possible until the Air Force had become independent and self sufficient in various types of support equipment and components and gained the expertise to procure and maintain them. Despite attempts to coordinate activities from its earliest stages, development of the giant B–36 bomber in the mid–1940s highlighted the flaws of the traditional practice of procuring the airframe, engines, navigation aids, fire control system, ground equipment, etc., from different sources and then relying on the airframe manufacturer to fit them together and make them function as a unit.

Although the B–47 medium bomber and F–102 interceptor were two of the first aircraft to be ostensibly developed from early on as weapon systems, management mistakes and technical obstacles resulted in both experiencing numerous delays, modifications, cost overruns, and chronic performance deficiencies.* With the B–52 heavy bomber, however, the Air Force applied weapon system management with more success. Using Boeing as its prime contractor, the Air Force developed in one integrated package what has become the world's longest serving combat aircraft.

Adoption of the weapon system concept corresponded closely with the formation of a single dedicated field element to manage all aspects of the development and procurement of a specific system. First named in 1951 as a weapon system project office (WSPO)—although sometimes referred to under an earlier name of joint project office (JPO)—this type of organization had been endorsed by Cook-Craigie plan in 1953. The WSPO could trace its roots to the B–29 bomber in 1942, when Brig. Gen. Kenneth B. Wolfe had become the first program official to exercise development, production, and deployment responsibilities. WSPOs pulled together members of ARDC, AMC, the operational command(s) who would use the system, Air Training Command, and various other agencies involved in developing and operating the system. WSPOs also maintained close liaison with the contractors involved.

Even though the WSPO members worked together, usually under one roof, the separation of development and procurement into two MAJCOMs with parallel reporting channels and loyal-

*The B–47 nevertheless played an important role in the Cold War as a forward-based jet bomber well into the 1960s.

ties made the concept tricky to implement. It was highly dependent on the personalities involved to operate smoothly. Conflicts over who was in control were alleviated by beginning a development program with the WSPO under overall direction of ARDC and then transferring program management responsibility (referred to at the time as "executive responsibility") from ARDC to AMC at the time of a production decision. The dual chains of command inevitably generated friction, however. Disputes that could not be resolved between the two headquarters had to be elevated to the Pentagon.

There, at Headquarters Air Force, both the Air Staff and the Secretariat shared in acquisition matters. In the former, the DCS/Logistics oversaw most AMC functions, while the DCS/Development did the same for ARDC. The strong-willed Trevor Gardner, who had been the Secretary of the Air Force's Special Assistant for Research and Development, became the first Assistant Secretary for R&D in 1955. AMC fell under the purview of the Assistant Secretary for Materiel.

Building upon the Cooke-Craigie plan, the weapons system approach also fostered the acquisition strategy of "concurrency" in an attempt to deal with the increasing time required to field more complex systems. By the mid–1950s, the services took on high priority "crash" programs to deploy intermediate-range and intercontinental ballistic missiles (IRBMs and ICBMs) as rapidly as possible. Instead of following the deliberately paced step-by-step process of research, development, testing, fixing, retesting, evaluating, producing, and deploying weapons and their major components, the Air Force condensed these steps into a carefully orchestrated effort to overlap them as much as possible. Concurrency was somewhat reminiscent of the streamlined procurement of World War II, but the increased sophistication of the weapons being developed demanded much more intensive planning and coordination. The need for preparations to field a weapon system and all its subsystems to overlap or take place simultaneously mandated a single focal point to control the entire acquisition process.

After the Soviet test of a hydrogen bomb in 1953, ballistic missile development began to become a national priority on the scale of the Manhattan Project of World War II. Trevor Gardner championed special command arrangements for the Air Force ICBM program, implemented in 1954, which cut across

the jurisdictional lines separating ARDC and AMC. Authority flowed from the Secretaries of Defense and Air Force (both of whom were advised by a special scientific committee) through the CSAF (who had an Assistant Chief of Staff for Guided Missiles) and the ARDC commander to Brig. Gen. Bernard A. Schriever—who had been appointed to manage the Atlas missile program on 5 May 1954. Dual-hatted in 1955 as ARDC Deputy Commander for Ballistic Missile Programs and Commander of ARDC's Western Development Division (ancestor of today's Space and Missile Systems Center) at Inglewood, California, General Schriever enjoyed unprecedented authority over the Atlas and, starting in 1955, the parallel Titan ICBM program.*

Bernard Schriever pioneered both the ultimate realization of the WSPO concept and the strategy of concurrency. He also pioneered the use of a special technical contractor for system engineering—the Ramo-Wooldridge Corporation—rather than relying on the prime production contractor.† The Western Development Division moved near Los Angeles International Airport in 1955 and was renamed the Air Force Ballistic Missile Division in 1957. It used subcontracting on a grand scale, and AMC established a Special Aircraft Project Office (renamed the Ballistic Missile Office in 1956) to support the ARDC Division. The Air Force Ballistic Missile Division also managed the Thor IRBM program and—of profound significance to future American intelligence capabilities—the WS–117L reconnaissance satellite program.

Taking advantage of its privileged management arrangements, the Ballistic Missile Division enjoyed funding priority after the wake-up call of Sputnik in October 1957. In a crash effort to close the perceived "missile gap," it employed concur-

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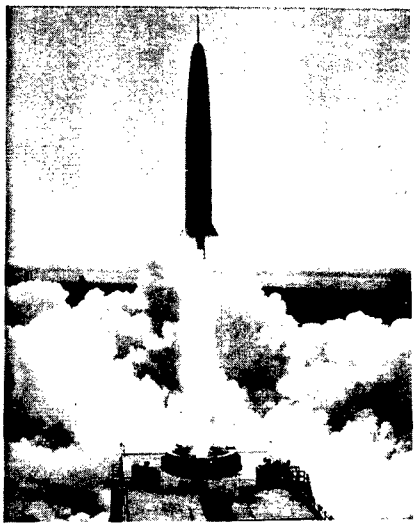
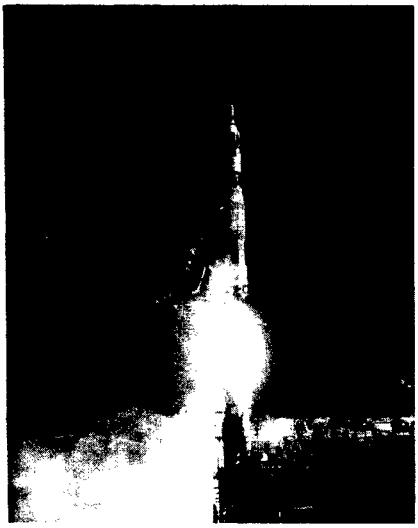
*In a very different organizational and political environment, the Navy's Hyman Rickover, dual-hatted as chief of the Nuclear Power Division in the Bureau of Ships and head of the Atomic Energy Commission's naval reactors program, supervised development of the nuclear powered submarine Nautilus, launched in 1954. His continued authority over nuclear submarine development for the next two decades went far beyond that of any other program executive in modern American military history.

†Ramo-Wooldridge later combined with Thompson Products to form the TRW Corporation, which in 1960 spun off the nonprofit Aerospace Corporation to perform space system engineering for the Air Force.



Brig. Gen. Bernard A. Schriever (*above left*) pioneered the weapon systems management concept in developing the Air Force's first generation of ballistic missiles. These included the Douglas Thor missile (*above right*) being tested at Cape Canaveral in 1958, Convair Atlas Missile (*below left*) being launched by an operational crew at Vandenberg AFB circa 1959, and Martin Titan I (*below right*) being tested at Cape Canaveral in 1960. General Schriever later became the first commander of Air Force Systems Command.



rency to develop and deploy the new U.S. missiles and their subsystems, launch sites, support equipment, and crews—all at the same time. Although this effort—which entailed the largest construction project of its time—led to cost overruns, extensive modifications, and unrealistic training, it truly achieved the goal of giving the United States a ballistic missile deterrent as soon as possible. The Strategic Air Command (SAC) and Royal Air Force reached operational status with a Thor IRBM squadron at RAF Feltwell in June 1959. SAC achieved an initial ICBM operational capability in September 1959 when its first Atlas Squadron went on alert at Vandenberg AFB, California. The first squadron of the more capable Titan became operational at Lowry AFB, Colorado, in April 1962. By the Cuban Missile Crisis in October 1962, the first ten solid-fuel Minuteman ICBMs came on alert at Malmstrom AFB, Montana.

The speedy deployment of ballistic missiles served as a model to ARDC and its allies for expanding the systems approach to management of aircraft and other acquisition programs. The AMC leadership, by and large, remained suspicious of delegating too much authority to program offices. In general, ARDC felt AMC hampered development through its control of funds, while AMC thought the R&D process extended too far into the production phase. Despite their differences, both commands cooperated as needed in the late 1950s to fend off creation of any weapons systems coordination office at Headquarters Air Force. As with missiles, they designated parallel field organizations to improve interface on other acquisition programs. AMC's Aeronautical Systems Center and ARDC's Wright Air Development Center (later Division) worked together on aircraft development at Wright-Patterson, while AMC's Electronic Systems Center and ARDC's Command and Control Development Division at Hanscom AFB, Massachusetts, dealt with communications, command, and control (C3) systems. In early 1958 Headquarters ARDC itself moved from Baltimore to Andrews AFB, Maryland, even closer to Washington, D.C.

Outside the Air Force, three organizations of great future significance to its own R&D aspirations were born in 1958. In February, the Secretary of Defense created the Advanced Research Projects Agency (ARPA). Although initially focusing on space programs and anti-missile defenses, ARPA received a broad charter to encourage innovative, long-term technologies. In Au-

gust the Defense Reorganization Act created the Director of Defense Research and Engineering (DDR&E) with the potential to oversee the services' R&D programs. In October 1958—one year after Sputnik—the National Aeronautics and Space Administration (NASA) was created on the existing framework of NACA to operate the nation's new civilian space program. Although primarily absorbing the Army's space and missile organizations (along with the legendary Wernher von Braun), NASA drew upon some Air Force resources as well.

Within the Air Force, the concurrency philosophy and the expectation that conventional combat operations were less relevant in the nuclear age led to a streamlining of the sequential test and evaluation process. T&E had been divided into seven phases in 1951 and expanded to eight in 1956. The last two phases were conducted by the Air Proving Ground Command and operational units. With encouragement from ARDC, the Air Force in 1957 abolished the Air Proving Ground Command to save money and to help expedite production decisions without the need first to complete operational testing. Then, in 1958, the Air Force replaced the eight-phase testing process with a three-category system: Category I by the contractor, Category II by an ARDC test center, and Category III (after production began) by the using command.

In May 1959, after numerous earlier studies, Headquarters Air Force formed the Weapons Systems Management Study Group to take a new look at the acquisition cycle and concurrency. The group included Gen. Samuel E. Anderson, who had been promoted from commander of ARDC to that of AMC in March 1959, as chairman, as well as his new replacement at ARDC, General Schriever. Unable to agree on a single solution, the group presented the options of re-combining the two commands, transferring procurement authority to ARDC, or making other less sweeping adjustments. In June 1960 Gen. Thomas D. White, CSAF, vetoed the first two options, and the Group then reached a compromise on better defining authority at each stage of the acquisition cycle. The procedures were implemented by a new series of regulations, one of which strengthened the WSPO and renamed it the System Program Office (SPO). The dropping of the word "weapon" also recognized the growing importance of C3, surveillance, and other technologies that supported war fighting. The friction between

ARDC and AMC continued, however. General Schriever, who recognized what today would be called the different "cultures" of the two commands, continued to seek procurement authority for ARDC.

The Ascendancy of Systems Command, 1961–1986

The Kennedy administration, with Robert S. McNamara as Secretary of Defense, brought more emphasis on the nation's space programs. This presented the Air Force another chance to realign its procurement responsibilities as part of a broader roles and missions adjustment. In March 1961 the Deputy Secretary of Defense Roswell L. Gilpatric made Secretary of the Air Force Eugene M. Zuckert an offer the Air Force could not refuse—responsibility for the military space program—if it reformed its acquisition structure to accommodate this mission. Headquarters Air Force almost immediately adopted General Schriever's previously rejected position. Effective 1 April 1961, ARDC expanded into a new Air Force Systems Command (AFSC), gaining its long–sought authority for procurement. AMC, which was redesignated Air Force Logistics Command, (AFLC), transferred its three systems centers and numerous contract management offices to AFSC. The ARDC Research Division, which focused on basic research, was transferred to Headquarters Air Force as the Office of Aerospace Research.

On 1 July 1962, Headquarters Air Force combined its DCSs for Materiel and Development into a new DCS for Systems and Logistics with the intention of providing integrated acquisition and support guidance to both commands. For designated acquisition programs, managers in the field were to use "redline" procedures to report directly to system offices in the Pentagon for decisions by a Systems Review Board (much as General Schriever had done with the Atlas and Titan). The Air Staff also formed a new DCS for Research and Technology to focus on basic and applied research that was not part of a specific system.

General Schriever, who would lead AFSC through August 1966, promptly reorganized his new command to take on procurement and contracting responsibilities. He expanded the

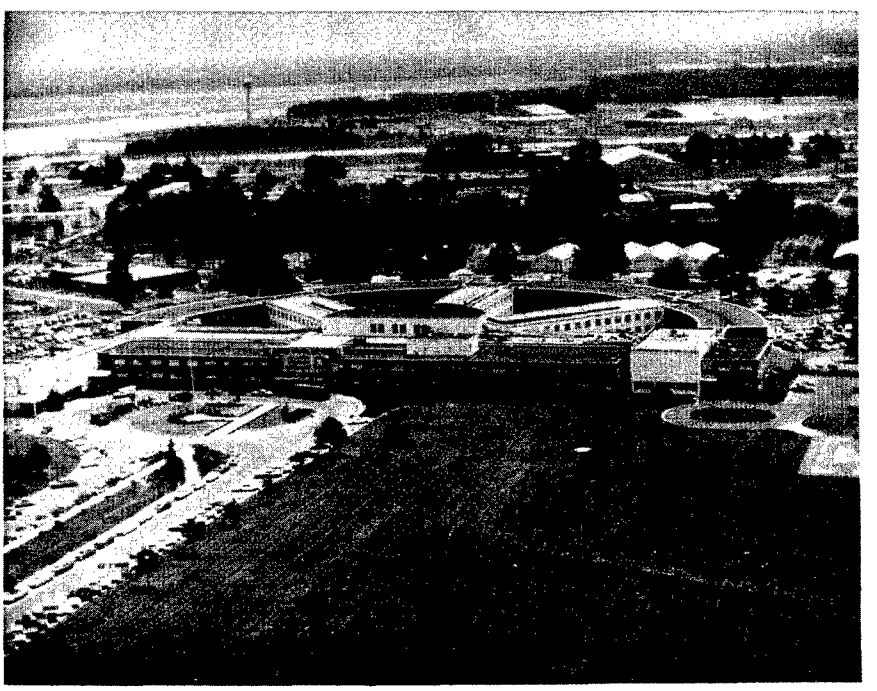
weapon system approach and otherwise institutionalized the principles he had employed in the ballistic missile programs. Under the new AFSC-AFLC relationship, the SPO was responsible for program management well into production. At a mutually-agreed time after deployment, a program management responsibility transfer (PMRT) between an AFSC product division and an AFLC logistics center would occur. Most of the SPOs fell under one of these product divisions, which included Aeronautical Systems Division at Wright-Patterson AFB, Armament Division at Eglin AFB, Electronic Systems Division at Hanscom AFB, Space Systems Division at Los Angeles Air Force Station, Ballistic Missile Division at Norton AFB, California, and Aerospace Medical Division at Brooks AFB, Texas. (The new Air Force Communications Service, formed on 1 January 1962, later assumed management of non-tactical communications and computer systems.) Other AFSC divisions performed special roles. The Contract Management Division in Los Angles oversaw production at contractors' plants, the Foreign Technology Division at Wright-Patterson AFB analyzed threat systems, and the Research and Technology Division, first located at Bolling AFB, D.C., managed many of AFSC's laboratories.

By 1963 the "redline" management technique, which had worked well for a few top priority programs, had been found wanting when used routinely. The type of information provided by SPOs to the system offices in the Pentagon dealt with individual problems and limited data, not the total program analyses needed to make major decisions on resource allocation and priorities. To provide the detailed information and evaluations required, the number and types of reviews multiplied, as did the layers of management oversight within AFSC and Headquarters Air Force. At the top was the Office of the Secretary of Defense (OSD) and its new requirements for cost effectiveness data and disciplined programming and budget schedules. To provide a more transparent interface with the field, the DCSs for Systems and Logistics and the DCS for Research and Development were realigned to parallel the functions of AFLC and AFSC respectively.

Although AFSC, in one sense, owed its existence to Robert McNamara, the secretary's management philosophy put heavy demands on the new command. In addition to the programming

and budgeting system featuring five-year defense plans and rigorous use of models and cost-benefit analyses in all decisions, McNamara introduced revolutionary contracting methods and a total package procurement concept. This concept gave wide programmatic responsibilities to prime contractors to both develop and produce systems—offering greater rewards but presenting greater risks. The scope of the programs made cost predictions difficult and led to unrealistic bids. Another characteristic of the new concept was a proliferation of detailed proposals, studies, and paper competitions, followed up by reports, audits, program reviews, and other oversight tools. All of these requirements focused power in OSD, including a more powerful DDR&E. To interface with OSD, Headquarters Air Force had to establish parallel management structures which, for example, increased the importance of program element monitors (PEMs).

Secretary McNamara also sought to improve standardization and inter-operability while reducing duplication and unneeded competition among the services. Other goals included improving conventional warfare capabilities to support the Kennedy



AFSC Headquarters building at Andrews AFB in the early 1960s.

Administration's new defense policy of flexible response. Although OSD brought many beneficial reforms, consistencies, and cost savings, its total package procurement concept and desire for commonality led to some embarrassments in weapons development. Most notable was the attempt to develop the Tactical Fighter Experimental (TFX)—which became the F–111—as a multi-purpose aircraft for both the Air Force and the Navy. With the giant C–5A transport, the total package procurement concept inspired an unrealistically low bid and thereafter limited the ability of AFSC and its SPO to correct the cost overrun problem.

Meanwhile, AFSC had to turn much of its attention from developing new systems to modifying existing ones to meet requirements of the war in Southeast Asia. The Century series of nuclear strike and interceptor aircraft proved less than desirable for conventional combat, and the Air Force had to adapt the Navy's A–1 Skyraider, A–7 Corsair, and F–4 Phantom II for its own uses. Successful AFSC innovations included gunships, sensors, drones, electronic jamming pods, and precision-guided weapons. AFSC also filled the gap created by NASA's de-emphasis on aeronautics in favor of space technology by conducting a wide variety of applied research on high-performance flight. Problems encountered in Vietnam, however, led to a perception affecting all the services that many sophisticated weapons did not perform as advertised. Some were unreliable and difficult to maintain in the heat and humidity; others proved too difficult for the average soldier or airman to employ in real combat. In a sample of 22 weapon systems deployed to Southeast Asia from 1965–1970, DoD studies found all but one had suffered major deficiencies in the field.

In view of such analyses, cost overruns, congressional concerns, and unfavorable media attention, the new Nixon administration began another round of acquisition reforms in 1969. Deputy Secretary of Defense David Packard (co-founder of Hewlett-Packard) led these efforts. New policies included detailed selected acquisition reports to Congress, more realistic cost estimates, more precisely defined operational requirements, technical risk analyses, less concurrency in favor of sequential schedules, a return to the practice of building prototypes, and—for aircraft—competitive "fly-offs" between contractors. Packard also established the Defense Systems Ac-

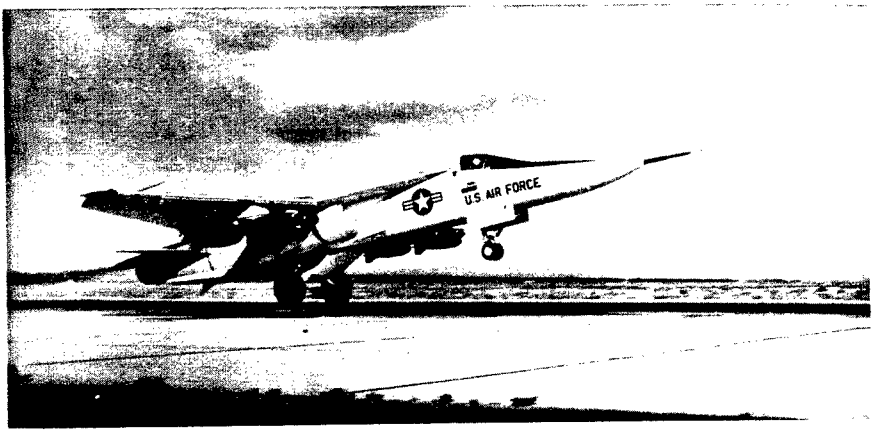
quisition Review Council (DSARC), forerunner of today's Defense Acquisition Board (DAB), to review program status and recommend milestone decisions to the Secretary after each phase of a major program from concept definition through development to production. While further standardizing OSD review and decision-making, the Under Secretary's reforms also called for giving program managers more tenure and broader authority. In retrospect, the need for centralized program reviews and oversight seems inherently at odds with the goal of decentralizing program management.

In July 1970 the report of President Nixon's Blue Ribbon Defense Panel endorsed many of these steps and called for some others, such as the establishment of independent operational test and evaluation (OT&E) organizations to help ensure that complex weapon systems really worked in the field. In 1971 Mr. Packard introduced the requirement to supplement development test and evaluation (DT&E) with an initial operational test and evaluation (IOT&E) before production, which was mandated by Congress later in the year. Many institutions within the Air Force, especially Systems Command, opposed creation of a separate operational test agency. But after more pressure from outside the Air Force, CSAF Gen. George S. Brown (formerly the AFSC Commander) ordered formation in 1974 of the Air Force Test and Evaluation Center (renamed the Air Force Operational Test and Evaluation Center or AFOTEC in 1983).

In other areas, Headquarters Air Force and AFSC enthusiastically embraced steps to adapt acquisition management practices to the Packard initiatives as the command developed new weapons that would serve the Air Force well in the decades to come. With the new F–15 air superiority fighter, for example, AFSC emphasized field management with the appointment of a general officer as SPO director in 1969. By year's end the Air Staff had shifted PEMs for the F–15, C–5A, Minuteman, and Airborne Warning and Control System (AWACS) to Headquarters AFSC. Lt. Gen. James T. Stewart, Commander of Aeronautical Systems Division from 1970–1976, was especially influential in modernizing the USAF inventory for the post-Vietnam era with a new generation of aircraft.

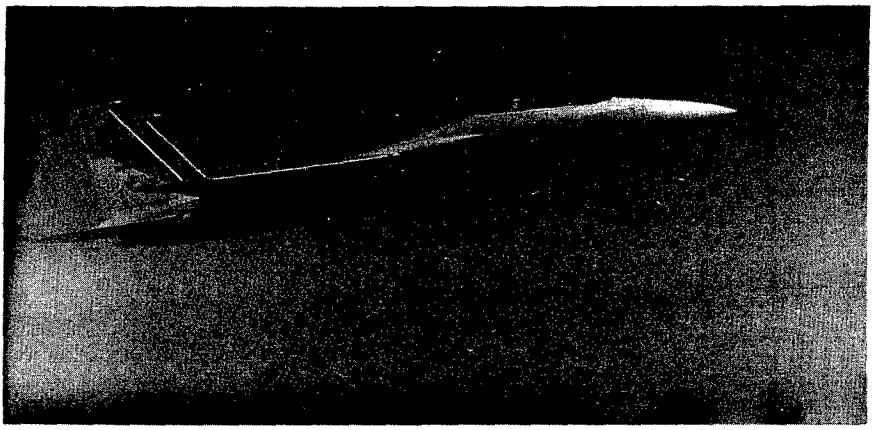
The 1970s brought administrative changes, such as a comprehensive series of formal program reviews, to keep AFSC and

Selected Fighter Aircraft of the 1960s and 1970s



The General Dynamics F–111A, which originated as part of the controversial TFX program, eventually became a highly capable long-range strike aircraft.

The Navy-developed McDonnell Douglas Phantom II, as adapted for the Air Force as the F–4C, became the workhorse of the war in Southeast Asia and the cornerstone of USAF tactical capabilities through the 1970s.



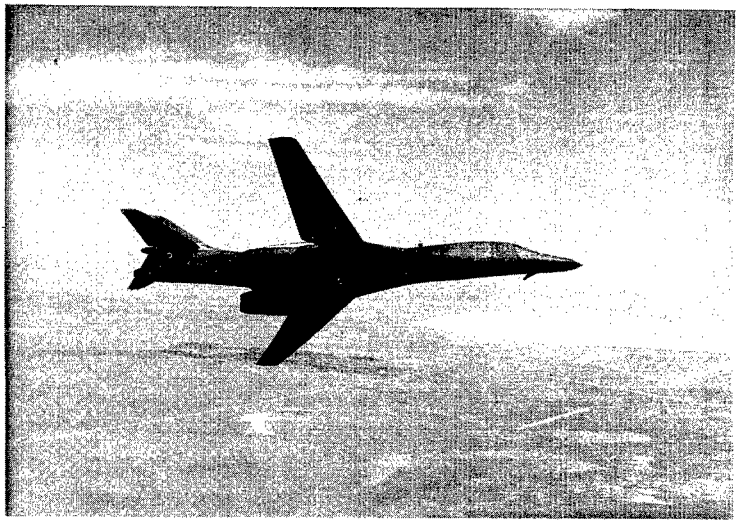
McDonnell Douglas F-15A test aircraft over Edwards AFB in the early 1970s.

The General Dynamics YF-16 was developed for the Lightweight Fighter Demonstration/Validation, a very successful prototype program of the mid-1970s. It led to the F-16 Fighting Falcon, which equips the air forces of 18 nations.

Air Force headquarters, OSD, and Congress informed of major programs while still allowing delegation of authority. Meanwhile, Packard's "fly before buy" philosophy was put into practice with competitive prototype and demonstration/validation projects, such as the Lightweight Fighter (YF–16 and YF–17), A–X Close Air Support (A–9 and A–10), and short take-off transport (YC–14 and YC–15) programs. Highly complex programs with far-reaching new capabilities, such as the E–3 AWACS, were marked by thorough DT&E and OT&E. At the same time, AFSC became increasingly involved in special access required (SAR) or "black" programs, which included low-observable technologies fostered by the Defense Advanced Research Projects Agency and sophisticated reconnaissance programs under the aegis of the Intelligence Community.

The philosophies expounded by Under Secretary Packard continued to gain momentum even after he left OSD in 1971. In 1976 the Office of Management and Budget (OMB) released two circulars (A–102 and A–109). Citing poor cost-estimating techniques, threat analysis, and need statements as well as program instability and excessive technological risk-taking, OMB called for stating objectives in terms of missions, not equipment, emphasizing contractor competition from the start, keeping Congress informed of the relationship between specific programs and overall DoD needs, drawing clear lines of authority and accountability, and improving the status of program managers. In response, OSD strengthened the DSARC review process, and the Air Force established an Air Force Systems Acquisition Review Council (AFSARC) to conduct internal reviews. Headquarters AFSC, in turn, implemented numerous panels and other management tools to keep track of program progress, control costs, and encourage competition among contractors.

At the same time, Air Force Logistics Command launched a new examination of how to deal with the discontinuity inherent in the program management responsibility transfer (PMRT). One result was the creation at Air Staff direction of the Acquisition Logistics Division at Wright-Patterson in 1976. Its mission was to serve as a watchdog over AFSC product divisions to ensure that reliability, maintainability, and supportability were built into weapon systems. AFLC and AFSC also devised several mechanisms and conducted comprehensive reviews to



The Rockwell B–1B, shown here over Edwards AFB in the early 1980s, illustrated the risks of concurrent development, production, and testing.

provide more timely and smoother PMRTs, but certain disconnects remained. In 1979 Headquarters Air Force chartered a study team which recommended further refinements of the process, but it left AFLC convinced that only close and continuous attention to each program by the two commands and their field units could alleviate the problems inherent in the hand-off of responsibility.

Although the administration of President Jimmy Carter initially canceled some major acquisition programs, such as the B–1 bomber, it generally continued on the same path as the Ford administration in regards to acquisition policies. Recognizing an intensification of the Cold War, the Carter administration began to increase defense funding in its last two years. The administration of President Ronald Reagan, who had promised an accelerated defense buildup during the 1980 campaign, then brought a new round of changes in the acquisition process. In early 1981, Deputy Secretary of Defense Frank C. Carlucci launched a program of 32 acquisition-related initiatives. Among these, he fostered decentralization to the services (e.g., by doubling the dollar thresholds for programs requiring DSARC reviews), encouraged the tailoring of management practices to suit specific programs, and encouraged multi-year

procurement, budgeting flexibility, and pre-planned product improvement. AFSC adopted and adapted a vast majority of the Carlucci initiatives.

The problems with the reliability, maintainability, and supportability of ever more complex new systems that were addressed in the Carlucci initiatives also highlighted the continued split in responsibilities in the Air Force between acquisition and logistics. To cement the Acquisition Logistics Division's relationship with Systems Command elements, AFSC and AFLC agreed in 1983 to replace the division with a dual-manned Air Force Acquisition Logistics Center, which became a special operating agency of Headquarters Air Force on 1 July 1984. In hindsight, this reuniting of the two commands at Wright-Patterson was a harbinger of more sweeping changes to come in the next several years.

Reform, Streamlining, and Centralization, 1986–1996

The Reagan defense buildup reached its peak during the command of Gen. Lawrence A. Skantze, who led AFSC from 1984–1987. The command's projects encompassed numerous major programs, more of them than ever hidden in the "black world" of special access programs. Those conducted in the open came under ever closer public scrutiny, especially in the late 1980s. Many major new Air Force systems—whether aircraft, missiles, satellites, or command and control equipment—relied increasingly on computer hardware and software for both performance and maintenance diagnostics. This was especially true for electronic warfare, avionics, and command and control capabilities. Numerous unanticipated problems were encountered, especially during subsystems integration. In some cases, most publicly for the Air Force with the resurrected B–1B bomber, such problems provided fodder for critics of the acquisition management process. By the mid and late 1980s, evidence of waste and corruption—most infamously those identified by the "Ill-Wind" investigation of extortion, bribery, and kickbacks involving some contractors, consultants, and DoD (mostly Navy) officials—further wounded the credibility of the acquisition system.

The 1980s brought the apex of the Congressional Military Reform Caucus, a bipartisan coalition of senators and representatives supported by the General Accounting Office (GAO) and various analysts and pundits. The tenets generally shared by caucus members included a distrust of concurrent development, testing, and production. Many also expressed a belief that DoD should decrease its reliance on small quantities of expensive "high tech" airborne systems in favor of larger numbers of simple, single-mission aircraft reminiscent of those used in World War II. The Caucus exerted considerable influence on the acquisition process prior to Operation Desert Storm in 1991, when the remarkable performance and reliability of a host of sophisticated aerospace systems proved certain assumptions regarding the disadvantages of technology expounded by some of the more vocal members of the Caucus had been seriously flawed.

Pressures for reform in the late 1980s also came from other directions. Once again, David Packard was the most influential, this time as chairman of President Reagan's Blue Ribbon Commission on Defense Management. Formed in 1985, the Packard Commission released its final report in June 1986. Among a host of recommendations, it called for DoD to "establish unambiguous authority for overall acquisition policy, clear accountability for acquisition execution, and plain lines of command for those with program management responsibilities." The Commission called for a streamlined structure consisting of a Defense Acquisition Executive (DAE) who would act like the chief executive officer of a major corporation, Service Acquisition Executives (SAEs) to perform as CEOs of principal corporate subsidiaries, Program Executive Officers (PEOs) to manage a select number of related major programs, and program managers (PMs) who would report directly and exclusively to their respective PEO.*

The second major influence was the Goldwater-Nichols Department of Defense Reorganization Act of 1986. Although best known for strengthening the Chairman of the Joint Chiefs of Staff and the unified commands, it also contained provisions intended to encourage civilian control and trim duplicative func-

*This streamlined reporting chain is reminiscent of the "redline" technique attempted by the Air Force in the early 1960s. See above pages 31-32.

tions within the service headquarters by eliminating military acquisition staffs and consolidating this function as part of the service secretariats.

Even before the Packard Commission's final report, President Reagan began to implement its interim recommendations by issuing National Security Decision Directive 219 on 1 April 1986. This established an Under Secretary of Defense (Acquisition) to set policy for and oversee program management through the new SAEs and a number of high-level committees with interlocking membership. The most influential of these became the DAB (which replaced the DSARC),* the Joint Requirements Oversight Council, and the Defense Planning and Resources Board. Each of the military departments, in turn, was to appoint service acquisition executives to interface with the new Under Secretary (often referred to as the "Acquisition Czar"). On 18 February 1987, Secretary of the Air Force Edward C. Aldridge informed the Secretary of Defense that most of the staff of the DCS/Research, Development, and Acquisition (AF/RD) would be combined with that of the Assistant Secretary of the Air Force (Research, Development, and Acquisition) (SAF/AL) to form the office of the new Assistant Secretary of the Air Force (Acquisition) (SAF/AQ). Daniel S. Rak was named to fill the new position on a temporary basis on 7 April 1987, but the amalgamation of the two offices did not take place until a few months after John J. Welch was appointed as the Air Force's acquisition executive on 28 October 1987. The last holder of the AF/RD position, Lt. Gen. Bernard P. Randolph, soon went on to command AFSC, where he would have to deal with the Packard Commission recommendations for streamlining acquisition commands in the field.

At first the Air Force attempted to graft the new PEO idea on the existing framework of Air Force Systems Command by appointing the commanders of the product centers as PEOs, with the Commander of AFSC serving as the PEO for major systems that cut across product divisions. General Randolph also reduced the command's overhead, both at the headquarters and in the field, where, for example, he abolished the Contract Man-

*DAB members include the Undersecretary of Defense for Acquisition, the Vice Chairman of the JCS, the three service acquisition executives, and various OSD civilian officials.

agement Division. Pressure for a more fundamental overhaul continued, however, and the compromise PEO arrangement did not long endure. The Air Force formally established a separate PEO structure in the Pentagon on 15 February 1990. Organized as a direct reporting unit of SAF/AQ, it included six individual PEOs assigned the following families of systems: (1) strategic, (2) tactical strike, (3) tactical airlift, (4) space, (5) command, control, and communications, and (6) information support. On the same date AFSC transferred management responsibilities for 37 major programs to these PEOs. The product center commanders were re-titled as designated acquisition commanders (DACs) and left with management of lesser programs.

The new PEO structure broke the military chain of command that had run from the CSAF through the Commander of AFSC and the product division/center commanders to the individual SPOs and their program managers (PMs). It also cut away much of System Command's core mission. AFSC was left mainly with continued management of smaller programs, supporting (but no longer managing) the SPOs who reported to PEOs, and operating RDT&E facilities and laboratories. These changes left in doubt AFSC's viability as a separate MAJCOM.

To study the feasibility of merging AFSC and AFLC into a hypothetical "AFXX," Lt. Gen. Charles C. McDonald, the Air Force DCS/Logistics, and Lt. Gen. John M. Loh, Commander of AFSC's Aeronautical Systems Division, co-chaired a panel in the summer of 1989. The study distinguished among common, similar, and unique functions performed by each command and the potential savings in merging the first two types of functions. It also looked at two potential models for AFXX: one based on the product division commanders serving as the program executive officers, the other assuming PEOs would be independent of the product divisions and have their own staffs. Both models had their advantages and disadvantages, but the group concluded that the second model adhered more closely to the spirit and intent of acquisition reform efforts. Any merger, however, would present the threat of major disruptions to the existing acquisition and logistics systems, which were already being significantly streamlined.

With talk of merger as a backdrop, the leadership of AFSC and AFLC fought what became a rear guard action to preserve

the integrity of their commands. As stated by the AFLC Commander, Gen. Alfred G. Hansen, "my concern is that we will take an efficient logistics structure and destroy it to fix an acquisition function that really needs only fine tuning.[5]" His counterpart at AFSC, General Randolph, felt much the same. He trimmed the size of his headquarters, abolished redundant field organizations, and relinquished traditional program management responsibilities to the newly emerging PEO structure. The two commanders' sincere efforts to downsize—and promises of more to come—convinced Gen. Larry D. Welch, CSAF, to set aside a preliminary determination in August 1989 to merge their two MAJCOMs.

This proved to be only a stay of execution. In the fall of 1989 the OSD followed up on the original Defense Management Review by beginning to issue a series of DMR Decisions (DMRDs), some of which were unfavorable for the Air Force keeping separate acquisition and logistics commands. DMRD 943, which in November 1990 proposed disestablishing AFSC and combining the remaining staff with AFLC, was the most obvious. Secretary of the Air Force Donald B. Rice soon made the decision that the time was ripe for their integration, but he allowed the two commands to determine how best to do it.

General McDonald and Gen. Ronald W. Yates (who had replaced General Randolph) and key members of their staffs quickly began to work on this mammoth and sensitive task. In an attempt to counter the appearance of returning to the past, they and the Secretary chose a new name—Air Force Materiel Command (AFMC)—and characterized the merger as a double liquidation, forming a new corporation from the assets of the dissolved companies. The new command's headquarters would replace that of AFLC at Wright-Patterson AFB but would incorporate as many personnel from Andrews AFB as possible. Recognizing the deep-seated cultural differences between the two commands, the leadership emphasized the need to forge a new partnership. The effort began in earnest after announcement of the decision on 10 January 1991 and accelerated after the establishment of a provisional AFMC headquarters at Wright-Patterson on 15 April 1991. This entity served as a planning element and then nucleus for a permanent, integrated headquarters. Much of the complicated melding process was completed on 1 July 1992, when Headquarters AFLC and

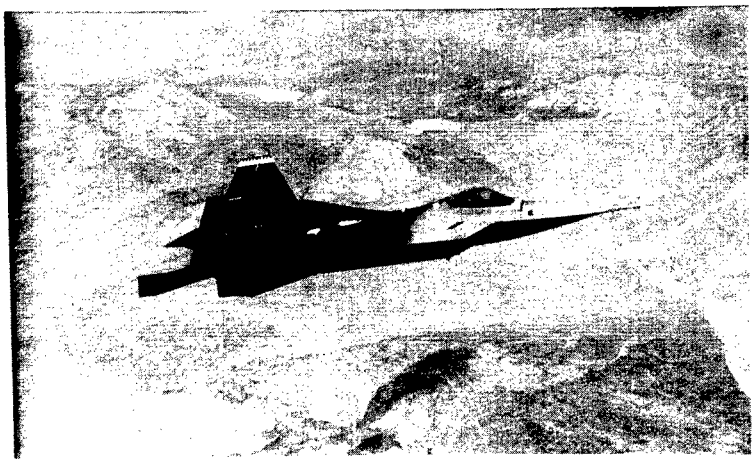
Gen. Ronald W. Yates, last commander of AFSC and first commander of AFMC.

Entrance to the Air Force Materiel Command Headquarters building, which had previously served as headquarters for Air Force Logistics Command and Air Materiel Command.

AFSC were officially replaced by Headquarters AFMC under the command of General Yates. AFMC also absorbed the acquisition functions of Air Force Communications Command (AFCC), which was reduced to a field operating agency (FOA) of the Air Staff.

In addition to the organizational and procedural changes set in motion by the Packard Commission, the entire acquisition career field was also revamped. A DMRD on 12 June 1989 had directed the services to correct deficiencies in the training and development of personnel involved in acquisition by devising plans for a dedicated corps of officers to serve as acquisition specialists. SAF/AQ and AFSC enhanced existing Air Force programs for both officers and career civilians. In 1990 Congress passed the Defense Acquisition Workforce Improvement Act, which created new formal standards for the services to manage their acquisition professionals. Among these were specific education, training, and experience requirements—with more stringent standards at the higher grades. Balancing opportunities for operational experience in the field with the new requirement for professional acquisition specialists represented a considerable personnel management challenge.

In June 1991 OSD distributed a comprehensive and inter-related new directive, instruction, and manual (all in the "5000" series of DoD publications) to govern the entire acquisition process. Replacing some 65 acquisition-related publications, the



The Lockheed YF-22, winner of the Advanced Tactical Fighter Competition of the early 1990s.

new guidelines standardized practices, correlated the acquisition management system with requirements definition and the planning, programming, and budgeting system, and emphasized timely documentation. Based mainly on program cost, the new directive defined four acquisition categories (ACATs) to more clearly differentiate the degree of oversight required. Program phases and intervening reviews ("milestones") were renamed and realigned, with six phases in the life cycle of a system identified as (1) mission need determination, (2) concept exploration and definition, (3) demonstration and validation, (4) engineering and manufacturing development, (5) production and deployment, and (6) operations and support. In mid-1991 Deputy Secretary of Defense Donald J. Atwood took additional steps to centralize acquisition authority in the OSD and provide even closer supervision over the services.

The SAF/AQ organization continued to develop in response to both DoD policies and changes in the Air Force. The end of the traditional dichotomy between strategic and tactical operations, which prompted the replacement of the war-fighting elements of the Strategic and Tactical Air Commands by Air Combat Command in 1992, led to the realignment of the PEOs. Strategic Systems became Fighter, C^2, and Weapons Programs; Tactical Systems became Combat Systems; and the word strategic was dropped from Strategic, Special Operations Forces, and Airlift. By mid–1996, there were eight PEOs: Fighters & Bombers; Weapons; Airlift and Trainers; C^3; Battle Management; Joint Logistics Systems, Space; and Joint Advanced Strike Technology. Above the PEOs, SAF/AQ designated four mission area directors (MADs): Global Power; Global Reach; Information Dominance; and Space and Nuclear Deterrence.

The first half of the 1990s brought numerous refinements in the acquisition procedures and fine tuning of various management tools and techniques. Continued reductions in R&D and procurement funding made further downsizing of the acquisition workforce inescapable.* Acquisition leaders continued the quest for more efficient management, such as reducing over-

*Authorized Air Force acquisition manpower dropped from 28,997 in 1992 to 22,586 in 1995, with a further reduction of 30 percent projected through 2001.

head, cutting paperwork, deleting many military specifications, sharing components among the services, and using commercial purchasing practices. These goals complemented those of Vice President Albert Gore's National Performance Review. Both Secretary of Defense William J. Perry and Undersecretary of Defense (Acquisition and Technology) Paul G. Kaminsky had been heavily involved with the stealth systems initiated in the 1970s and favored much of the streamlined management used for special access programs. Other key tenets of DoD acquisition reform were to view industry as a partner, not an adversary, and to consider the cost of systems as an independent variable rather than an outcome of the acquisition process.

Tragedy struck the Air Force AQ community on 25 April 1995 when Clark G. Fiester, who had served as the Assistant Secretary for only one year, died in a C–21 crash in Alabama. Deputy Assistant Secretary Darleen Druyun acted as the Air Force acquisition executive for the next nine months. She pushed steps to further streamline the acquisition process wherever possible, issuing a series of reform measures known as "Lightning Bolt" initiatives.* Mr. Arthur L. Money, who became the new Assistant Secretary after being confirmed on 29 January 1996, carried on the push toward "faster, better, and cheaper" acquisition programs.

In the field, a hallmark of the new Air Force Materiel Command was the concept of integrated weapons system management (IWSM). With one command in charge of research, development, DT&E, acquisition, and logistics, it could appoint a single manager for each system and do away with the need for a PMRT. Although complicated to implement, the goal was simple: to establish seamless SPOs that would be responsible

*The eleven Lightning Bolt initiatives in brief: (1) centrally scrub all major requests for proposal; (2) create a standing acquisition strategy panel; (3) develop a new SPO manpower standard based on SAR programs; (4) cancel all AFMC center acquisition policies; (5) "reinvent" the AFSARC process using IPTs; (6) improve the consideration of past performance in making source selections; (7) consolidate documents required for milestone decisions into a single acquisition management plan; (8) incorporate acquisition reform into the PEO and DAC portfolios; (9) enhance workforce training and education; (10) cut contract award time in half; and (11) adopt business processes in laboratories.

for the wide range of activities needed to manage assigned systems and equipment "from cradle to grave." AFMC implemented the concept gradually, assigning candidate programs to SPOs at either product centers or logistics centers depending on their maturity and other characteristics. The expansion and refinement of the IWSM system toward meeting the principle of life-cycle management continued well into the mid–1990s.

Under General Yates, the command accentuated the Total Quality Management (TQM) approach begun by General Randolph in AFSC and later adopted Air Force-wide. It also sought to deal with programmed and anticipated personnel cuts through reengineering its processes and organizations. At the program level, the command adopted the use of integrated product teams (IPTs) and other innovations developed by managers such as Lt. Gen. James A. Fain, who supervised various acquisition programs (including the Advanced Tactical Fighter) at Aeronautical Systems Center from 1981 to 1992 and then served as the Center's commander from 1992 to 1994. Trends toward out-sourcing were reinforced by the decisions of the Base Realignment and Closure Commission in 1995 to shut down the Sacramento and San Antonio Air Logistics Centers and the Clinton administration's subsequent goal to "privatize" them in place. To lead AFMC toward meeting these changes and other challenges, Gen. Henry Viccellio Jr. assumed command on 30 June 1995.

With the cancellation of many acquisition programs after the end of the Cold War and the ever-escalating unit costs of the stretched out programs that remained, the life cycles of weapon systems continued to lengthen. By the mid–1990s, the Air Force had only three new major advanced aircraft programs in production or development: the B–2 stealth bomber, the C–17 transport, and the F–22 air superiority fighter. To upgrade the capabilities of aircraft already in the inventory and extend their service lives, existing models, such as the F–15 and F–16 underwent continuous modifications. RDT&E efforts no longer focused so much on aircraft themselves as on their avionics and weapons. Many of the new systems still being developed were unmanned air vehicles (UAVs), precision-guided munitions (PGMs), and command, control, communications, and computer (C^4) systems to exploit the force multiplier of information warfare, including space-based systems. Exemplifying these new

programs is the E–8 Joint Surveillance and Attack Radar System (J-STARS), which provides the Air Force and Army with a picture of the battlefield, much as the E–3 AWACS had revolutionized command and control of air operations. The only new tactical combat aircraft on the horizon is the stealthy, multimission joint strike fighter, an interservice program emphasizing affordability and versatility. The acquisition and logistics communities thus face the twin challenges of keeping old systems viable while fostering new technologies appropriate for the 21st century.

For the past eight decades the Air Force and its predecessors have striven to organize and manage the acquisition of weapons systems as effectively as possible. The chosen structures and processes reflected the technologies, politics, economics, world events, and prevailing corporate culture of the times. Occasionally old patterns reasserted themselves in new forms; at other times, true innovations emerged. If history is a guide, the acquisition management journey will continue to both retrace old paths and blaze new trails in the years ahead.

APPENDIX

KEY ACQUISITION ORGANIZATIONS AND LEADERS

Organization/Location	Commander	Month/Year
Air Service, U.S. Army (May 1918)		
Bureau of Aircraft Production		
Washington, D.C.	John D. Ryan*	May–Nov 1918
Airplane Engineering Division		
McCook Field, Ohio	Lt. Col. Jesse G. Vincent	Aug–Nov 1918
	Col. Thurman H. Bane†	Nov 1918–Jan 1919
Technical Division		
McCook Field, Ohio	Col. Thurman H. Bane	Jan–Mar 1919
Engineering Division		
McCook Field, Ohio	Col. Thurman H. Bane	Mar 1919–Jan 1923
	Maj. L. W. McIntosh	Jan 1923–Jul 1924
	Maj. John F. Curry	Jul 1924–Oct 1926
Air Corps, U.S. Army (July 1926)		
Materiel Division		
McCook Field, Ohio	Brig. Gen. William E. Gillmore	Oct 1926–Jun 1929
Wright Field, Ohio (March 1927)	Brig. Gen. Benjamin D. Foulois	Jul 1929–Jun 1930
	Brig. Gen. Henry C. Pratt	Jul 1930–Mar 1935
	Brig. Gen. Augustine W. Robins	Apr 1935–Feb 1939
	Brig. Gen. George H. Brett	Feb 1939–Oct 1940
Washington, D.C. (October 1939)		
	Brig. Gen. Carl A. Spaatz	Oct–Nov 1940
	Brig. Gen. Oliver P. Echols	Dec 1940–Nov 1942
U.S. Army Air Forces (June 1941)		
Materiel Command		
Washington, D.C.	Maj. Gen. Oliver P. Echols	Mar 1942–Mar 1943
Wright Field, Ohio (April 1943)	Maj. Gen. Charles E. Branshaw	Apr 1943–May 1944
	Maj. Gen. Bennett E. Meyers (Actg)	Jun–Jul 1944
	Brig. Gen. Kenneth B. Wolfe	Jul–Aug 1944

* Appointed as Director of Air Service and Second Assistant Secretary of War in August 1918.

† Began as chief of both the Airplane Engineering Division and the Technical Section of the Division of Military Aeronautics. Also served as Commandant of the Air Service Engineering School, which began its first formal class in November 1919.

KEY ACQUISITION ORGANIZATIONS AND LEADERS

Organization/Location	Commander	Month/Year
Assistant Chief of Air Staff, Materiel, Maintenance, and Distribution		
Washington, D.C. (March 1943)	Maj. Gen. Oliver P. Echols	Mar 1943–Jul 1944
Assistant Chief of Air Staff, Materiel and Services		
Washington, D.C. (July 1944)	Maj. Gen. Oliver P. Echols	Jul 1944–Apr 1945
	Maj. Gen. E. M. Powers	Apr 1945–Oct 1947
Air Technical Service Command		
Patterson Field, Ohio	Lt. Gen. William S. Knudsen	Sep 1944–Apr 1945
(September 1944)	Maj. Gen. Hugh J. Knerr	Jun–Dec 1945
	Lt. Gen. Nathan F. Twining	Dec 1945–Mar 1946
Air Materiel Command		
Patterson Field, Ohio (March 1946)	Lt. Gen. Nathan F. Twining	Mar 1946–Oct 1947
U.S. Air Force (September 1947)		
Major Commands		
Air Materiel Command		
Wright-Patterson AFB, Ohio	Gen. Joseph T. McNarney	Oct 1947–Aug 1949
	Gen. Benjamin W. Chidlaw	Sep 1949–Aug 1951
	Gen. Edwin W. Rawlings	Aug 1951–Feb 1959
	Gen. Samuel E. Anderson	Mar 1959–Mar 1961
Air Research and Development Command		
Wright-Patterson AFB, Ohio (January 1950)	Maj. Gen. David M. Schlatter	Feb 1950–Jun 1951
Baltimore, Md (June 1951)	Lt. Gen. Earle E. Partridge	Jun 1951–Jun 1953
	Lt. Gen. Donald L. Putt	Jun 1953–Apr 1954
	Lt. Gen. Thomas S. Power	Apr 1954–Jun 1957
Andrews AFB, Md (January 1958)	Lt. Gen. Samuel E. Anderson	Aug 1957–Mar 1959
	Maj. Gen. John W. Sessums Jr.	Mar–Apr 1959
	Lt. Gen. Bernard A. Schriever	Apr 1959–Apr 1961

*Wright and Patterson Fields were renamed Wright-Patterson AFB in January 1948.

KEY ACQUISITION ORGANIZATIONS AND LEADERS

Organization/Location	Commander	Month/Year
Air Force Systems Command		
Andrews AFB, Md (April 1961)	Gen. Bernard A. Schriever	Apr 1961–Aug 1966
	Gen. James Ferguson	Sep 1966–Aug 1970
	Gen. George S. Brown	Sep 1970–Jul 1973
	Gen. Samuel C. Phillips	Aug 1973–Aug 1975
	Gen. William J. Evans	Sep 1975–Jul 1977
	Gen. Lew Allen Jr.	Aug 1977–Mar 1978
	Gen. Alton D. Slay	Mar 1978–Feb 1981
	Gen. Robert T. Marsh	Feb 1981–Aug 1984
	Gen. Lawrence A. Skantze	Aug 1984–Jul 1987
	Gen. Bernard P. Randolph	Jul 1987–Apr 1990
	Gen. Ronald W. Yates	Apr 1990–Jul 1992
Air Force Materiel Command		
Wright-Patterson AFB, Ohio (July 1992)	Gen. Ronald W. Yates	Jul 1992–Jul 1995
	Gen. Henry Viccellio Jr.	Jul 1995–
Headquarters USAF, Air Staff		
Deputy Chief of Staff (DCS), Materiel		
	Lt. Gen. Howard A. Craig	Oct 1947–Sep 1949
	Maj. Gen. Kenneth B. Wolfe	Sep 1949–Jun 1951
	Lt. Gen. Orval R. Cook	Jul 1951–Mar 1954
	Lt. Gen. Bryant L. Boatner	Apr 1954–Apr 1955
	Lt. Gen. Clarence S. Irvine	Apr 1955–Apr 1959
	Lt. Gen. Mark E. Bradley	Jun 1959–Jun 1961
DCS, Systems and Logistics		
	Lt. Gen. Mark E. Bradley	Jul 1961–Jun 1962
	Lt. Gen. Thomas P. Gerrity	Jul 1962–Jul 1967
	Lt. Gen. Robert G. Ruegg	Aug 1967–Jul 1969
	Lt. Gen. Harry E. Goldsworthy	Aug 1969–Dec 1972
	Lt. Gen. William W. Snavely	Jan 1973–Aug 1975
	Lt. Gen. Robert E. Hails	Sep 1975–Jun 1977
	Lt. Gen. Thomas M. Ryan Jr.	Jul–Sep 1977
	Lt. Gen. John R. Kelly Jr.	Oct 1977–Jun 1978
DCS, Logistics and Engineering		
	Lt. Gen. John R. Kelly Jr.	Jun 1978–Apr 1979
	Lt. Gen. Billy M. Minter	May 1979–Jun 1982
	Lt. Gen. Richard E. Merkling	Jul 1982–Jul 1983

KEY ACQUISITION ORGANIZATIONS AND LEADERS

Organization/Location	Commander	Month/Year
DCS, Logistics and Engineering, cont'd.		
	Lt. Gen. Leo Marquez	Aug 1983–Jul 1987
	Lt. Gen. Charles C. McDonald	Aug 1987–Oct 1989
	Lt. Gen. Henry Viccellio Jr.	Oct 1989–Feb 1991
DCS, Development		
	Maj. Gen. Gordon P. Saville	Jan 1950–May 1951
	Maj. Gen. Donald L. Putt (Actg)	Jun–Nov 1951
	Lt. Gen. Laurence C. Craigie	Nov 1951–Apr 1954*
	Lt. Gen. Donald L. Putt	Apr 1954–Jun 1958
	Lt. Gen. Roscoe C. Wilson	Jul 1958–Jun 1961
DCS, Research and Technology		
	Lt. Gen. Roscoe C. Wilson	Jul–Nov 1961
	Lt. Gen. James L. Ferguson	Dec 1961–Jan 1963
DCS, Research and Development		
	Lt. Gen. James L. Ferguson	Feb 1963–Aug 1966
	Lt. Gen. Joseph R. Holzapple	Sep 1966–Jan 1969
	Lt. Gen. Marvin L. McNickle	Feb 1969–Jan 1970
	Lt. Gen. Otto J. Glasser	Feb 1970–Jun 1973
	Lt. Gen. William J. Evans	Aug 1973–Aug 1975
	Lt. Gen. Alton D. Slay	Sep 1975–Mar 1978
	Lt. Gen. Thomas P. Stafford	Apr–Jun 1978
DCS, Research, Development, and Acquisition		
	Lt. Gen. Thomas P. Stafford	Jun 1978–Oct 1979
	Lt. Gen. Kelly H. Burke	Nov 1979–Jul 1982
	Lt. Gen. Lawrence A. Skantze	Aug 1982–Oct 1983
	Lt. Gen. Robert D. Russ	Oct 1983–May 1985
	Lt. Gen. Bernard P. Randolph	May 1985–Mar 1987†
Headquarters USAF, Secretariat		
Assistant Secretary (Materiel)		
	Roswell L. Gilpatric	May–Oct 1951
	Edwin V. Huggins	Jan 1952–Feb 1953
	Roger Lewis	Apr 1953–Sep 1955

* From October 1953 to June 1955, the DCS/Development reported to the DCS Materiel.

† Most DCS/RD&A functions transferred to the new Assistant Secretary of the Air Force (Acquisition).

KEY ACQUISITION ORGANIZATIONS AND LEADERS

Organization/Location	Commander	Month/Year
Assistant Secretary (Materiel), cont'd.		
	Dudley C. Sharp	Oct 1955–Jan 1959
	Philip B. Taylor	Apr 1959–Feb 1961*
	Joseph S. Imirie	Apr 1961–Oct 1963
	Robert H. Charles	Nov 1963–Feb 1964
Special Assistant for Research and Development		
	William A. M. Burden	Sep 1950–Jun 1952
	Trevor Gardner	Feb 1953–Feb 1955
Assistant Secretary (Research and Development)		
	Trevor Gardner	Mar 1955–Feb 1956
	Richard E. Horner	Jul 1957–May 1959
	Joseph V. Charyk	Jun 1959–Jan 1960
	Courtland D. Perkins	Feb 1960–Jan 1961
	Brockway McMillan	Jun 1961–Jun 1963
	Alexander H. Flax	Jul 1963–Mar 1969
	Grant L. Hansen	Mar 1969–May 1973
	Joe C. Jones (Actg)	Jun–Sep 1973
	Walter B. LaBerge	Sep 1973–Mar 1976
	John J. Martin	Mar 1976–May 1977
Assistant Secretary (Research, Development, and Logistics)		
	John J. Martin	May 1977–May 1979
	Robert J. Hermann	Jul 1979–Aug 1981
	Alton G. Keel	Aug 1981–Sep 1982
	Martin F. Chen (Actg)	Sep 1982–Jan 1983
	Thomas E. Cooper	Jan 1983–Apr 1987
Assistant Secretary (Acquisition)		
	Daniel S. Rak (Actg)	Apr–Oct 1987
	John J. Welch Jr.	Oct 1987–Apr 1992
	G. Kim Wincup	May–Dec 1992
	Darlene A. Druyun (Actg)	Jan 1993–May 1994
	Clark G. Fiester	May 1994–Apr 1995
	Darlene A. Druyun (Actg)	Apr 1995–Jan 1996
	Arthur L. Money	Feb 1996–

*With transfer of procurement responsibilities from Air Materiel Command to the new Air Force Systems Command in April 1961, most acquisition-related matters migrated to the Assistant Secretary (R&D).

GLOSSARY OF ABBREVIATIONS

AAF	Army Air Forces
ACAT	Acquisition Category
AFB	Air Force Base
AFLC	Air Force Logistics Command
AFMC	Air Force Materiel Command
AF/RD	DCS, Research, Development, and Acquisition (office symbol)
AFSARC	Air Force Systems Acquisition Review Council
AFCC	Air Force Communications Command
AFOTEC	Air Force Operational Test and Evanuation
AFSC	Air Force Systems Command
AL	Assistant SAF, Research, Development, and Acquisition (office symbol)
AMC	Air Materiel Command
AQ	Assistant SAF for Acquisition (office symbol)
ARDC	Air Research and Development Command
ARPA	Advanced Research Projects Agency
AWACS	Airborne Warning and Control System
C^2	Command and Control
C^3	Command, Control, and Communications
C^4	Command, Control, Communications, and Computers
CEO	Chief Executive Officer
CSAF	Chief of Staff, Air Force
DAB	Defense Acquisition Board
DAC	Designated Acquisition Commander
DAE	Defense Acquisition Executive
DCS	Deputy Chief of Staff
DDR&E	Director of Defense Research and Engineering
DMR	Defense Management Review
DMRD	DMR Decision
DSARC	Defense Systems Acquisition Review Council
DT&E	Development Test and Evaluation
FOA	Field Operating Agency
GAO	General Accounting Office
ICBM	Intercontinental Ballistic Missile
IOT&E	Initial Operational Test and Evaluation
IPT	Integrated Product Team
IRBM	Intermediate Range Ballistic Missile

IWSM	Integrated Weapon Systems Management
JPO	Joint Program Office
MAD	Mission Area Director
MAJCOM	Major Command
NACA	National Advisory Committee for Aeronautics
NASA	National Aeronautics and Space Administration
OSD	Office of the Secretary of Defense
OT&E	Operational Test and Evaluation
OMB	Office of Management and Budget
PEM	Program Element Monitor
PEO	Program Executive Officer
PM	Program Manager
PMRT	Program Management Responsibility Transfer
R&D	Research and Development
RDT&E	Research, Development, Test, and Evaluation
SAC	Strategic Air Command
SAE	Service Acquisition Executive
SAF	Secretary of the Air Force
SAR	Special Access Required
SPO	System Program Office
TAC	Tactical Air Command
TQM	Total Quality Management
WSPO	Weapon System Project Office

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1. I. B. Holley, *Buying Aircraft*, page 4.

2. I. B. Holley, *Ideas and Weapons*, page 19.

3. I. B. Holley, *Buying Aircraft*, page 109.

4. As quoted by Robert F. Futrell in *Ideas, Concepts, and Doctrine*, Vol I, p. 276.

5. As quoted by H. P. Carlin in *Building a New Foundation,* p. 28.

Photographic Sources

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