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Seventies' Incidents Impacting Weapon System Acquisitions used in Desert Storm

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An F–15 from the 1st Tactical Fighter Wing, Langley AFB, Virginia, parked in a bunker in Southwest Asia during the beginnings of Operation DESERT SHIELD.

"To be prepared for war is one of the most effectual means of preserving peace. In jet-atomic warfare, there will be no room for gross errors of judgment. There will be no time, should hostilities start, to correct mistakes in the types of forces that we have provided, the manner in which they have been organized and trained, or the way we fight."

Lt Gen Laurence S. Kuter, November 24, 1955[1]

Just before dawn on August 2, 1990, Iraqi dictator Saddam Hussein deployed units of the Republic Guard Forces Command across the Kuwaiti border in a brutally swift assault that quickly seized Kuwait City, the country of Kuwait and by the second day of the invasion, had moved towards the Saudi Arabian border.[2] Saddam voiced "major grievances" before the invasion, alleging that Kuwaitis had stolen oil between the two countries, disregarding production limits set by the Organization of Petroleum Exporting Countries (OPEC) and thus driving down the price of oil as well as stating revolutionaries had overthrown the Kuwaiti government and requested his intervention.[3] On August 6, Saudi King Faud bin Abd al-Aziz met with a U.S. delegation that included Secretary of Defense Richard B. Cheney, Commander in Chief, U.S. Central Command (CENTCOM) U.S. Army General H. Norman Schwarzkopf, and Air Force Component Commander, CENTCOM, U.S. Air Force Lieutenant General Charles A. Horner in Jedda for the first time in Saudi history, where "the head of state agreed to accept the deployment of foreign troops into his country." Schwarzkopf appointed Horner as the CENTCOM forward commander with the responsibly of the beddown of forces that began flowing into the theater.[4] In addition to this partnership with the Saudis, President George H.W. Bush also molded the support of an international Coalition to "avoid a unilateral American intervention on behalf of the Saudis or any appearance that non-Arab countries from outside the Middle East were combining against a lone Islamic state." With this being said, the President built a diplomatic alliance which included many Arab countries that opposed Iraq's occupation of Kuwait, and on August 6 the United Nations Security Council imposed a trade embargo on Iraq.[5] Consequently, on the same day, President Bush directed U.S. military forces to deploy to the Persian Gulf with the McDonnell Douglas F–15C/D *Eagles* from the 1st Tactical Fighter Wing out of Langley AFB, Virginia, deploying within twenty-four hours to Saudi Arabia and forty-eight hours later flying defensive patrols over Saudi airspace, thus the beginnings of Operation DESERT SHIELD.[6]

Over the next five months, United States and Coalition forces deployed to the Persian Gulf to deter any further Iraqi aggression and "set the stage for offensive actions."[7] The buildup of Coalition forces began first with Saudi F–15Cs and Boeing E–3 *Sentry* Airborne Warning and Control Systems (AWACS) flying a 24-hour defense air patrol as coalition forces arrived. By the end of August, two fighter squadrons from the Royal Air Force were in place along with accompanying

F–15s from the 1st Tactical Fighter Wing, Langley AFB, Virginia, prepare to depart a base in Saudi Arabi to fly defense patrols over Saudi airspace during the beginnings of Operation Desert Shield.

tanker and maritime patrol aircraft, fifteen U.S. tactical fighter squadrons (U.S. Air Force and Marine Corps), three carrier battle groups, a B–52 squadron, four tactical airlift squadrons, seven Army and Marine Corps brigades with attack helicopters, and a Patriot air defense system. Due to a planned frontal assault and the likelihood of heavy Coalition losses, President Bush authorized additional ground and air forces to enhance Schwarzkopf's options. With this, the second phase saw an additional increase of 400 Air Force aircraft,[8] three carrier battle groups, and more than four Army and Marine divisions. By mid-January, the "Coalition forces included nearly 1,800 combat aircraft from 12 countries, a large naval force in the Persian Gulf and the Red Sea, and approximately 540,000 group troops from 31 countries. The total Coalition force numbered more than 660,000."[9] Just before the launching of combat operations on January 16, 1991, Air Force Chief of Staff General Merrill A. McPeak wrote to his former boss General Wilbur "Bill" Creech that they were about to "harvest the results of years of hard work and leadership" of Creech and a handful of other "great Airmen." He went on to state that, "We will do well. But we need to recognize that we are beholden to you, because you really built this magnificent Air Force we have today"[10] with General Horner echoing these same thoughts, stating that Creech had given the Air Force "the organization and training that made the success of our crusade possible."[11]

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During the early hours of January 17, over 160 tankers circled south of the Iraqi border following similar tracks they had used since August, escorted by F–15s and three E–3 AWACS peering into Iraq to keep tabs on their air forces. Gen McPeak, Chief of Staff of the U.S. Air Force, remarked later that what the Iraqis were seeing on their radar screens was nothing new that "we had been showing them since August." However, what the Iraqis did not see were the aircraft behind the tankers, the "stealth F–117s, the vanguard of the covert, stunning success air attack that would open" Operation DESERT STORM. At 0235, ten F–117s dropped from their tankers to innate targets within Iraq and four minutes after this, Sikorsky MH–53 *Pave Lows* and Boeing AH–64 *Apache* helicopters destroyed two electronic warfare sites in western Iraq, opening the corridor for McDonnell Douglas F–15E *Strike Eagles* to strike Scud sites.[12] By January 27, Coalition air forces achieved air supremacy, and a month later the war ended with a Coalition-declared cease-fire as the Iraqi army had been driven into a corner of southern Iraq.[13]

Predecessor units of Air Force Materiel Command (AFMC) played a major role in the Gulf War by designing, developing, testing, acquiring, and sustaining many of the frontline aircraft flown in the war – among them the F–15, General Dynamics F–16 *Fighting Falcon*, Fairchild Republic A–10 *Thunderbolt II*, and Lockheed F–117 *Nighthawk*[14] – along with developing and expanding the capabilities of other technologies and aircraft such as Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN), the Westinghouse AN/APG-68 and Hughes Aircraft AN/APG-70 attack radar with advanced cockpit displays, digital flight control technologies, improved fuels and engines, precision-guided weapons, and Global Positioning System (GPS). Pilots later claimed the AN/APG-70 attack radar in the F–15E and the AN/APG-68 in the F–16 offered "phenomenal" range and resolution. In interviews, they proclaimed, "if it had metal in it, we could find it," and 'with the APG-70, you could tell from 30 miles away whether a MiG-sized target had weapons or fuel tanks on it."[15] As authors Eliot Cohen and Thomas Kearney point out, by 1991

General Merrill A. McPeak, USAF Chief of Staff.

some post-Vietnam aircraft that had been operational for years along with the newer systems that had less than a year of service "was the combination of U.S. capabilities and coalition, not all of which were based on advanced technologies, that made airpower so predominant" during Desert Storm. It was with these new weapons that the older weapon systems like the F–111, A–6, and B–52 performed well with precision-guided and unguided bombs.[16] Through intelligence gained from the 1967 Domodedovo Russian air show to lessons learned from the Yom Kippur War to changing weapon acquisition practices, the major weapon systems utilized in the defeat of Iraqi forces during Desert Storm took their shape over 50 years ago during the early parts of the 1970s as a result of reappraisals of the perceived Soviet threat in Europe.

Soviets Burst on Scene

In July 1967 at the Domodedovo Civil Airport south of Moscow, the Soviet Union unveiled at the Tushino Air Show twelve new and advanced military aircraft in its first large airshow in nearly six years, displaying variable-sweep, vertical and/or short take-off and landing (V/STOL) attack, and short takeoff and landing (STOL) aircraft. Soviet Union's intentions with the airshow were to demonstrate their increasing capabilities in tactical warfare and ability to keep on pace with the West with the unveiling five new aircraft and four already in the active inventory but with significant upgrades with half of the aircraft developed by veteran designer Artem Mikoyan and the other three by Pavel Sukhoi's design bureau – the aerodynamic prototype MiG-23 *Flogger*, the swing-wing variants of the Sukhoi Su-7 *Fitter-A* and the Mach 3-plus MiG-25 *Foxbat*.[17] These airframes reflected the Soviet Union's new stress on improving their air support for theater forces and their first major public showing of combat aircraft since 1961. According to the Central Intelligence Agency, this suggested "Soviet intention to improve all aspects of fighter aviation," a "massive" move, as Dr. Richard Hallion states, to "diversify the types" and "reshape its tactical and air superiority force" from their first generation of transonic and supersonic fighters.[18] General John P. McConnell, Air Force Chief of Staff, in August 1968 before the Senate Preparedness Subcommittee, stated that with the unveiling of the Mikoyan *Foxbat* and other Soviet fighters dictated that "we produce a fighter aircraft *optimized for the air-to-air role*…. To keep pace with the Soviet advances," the U.S. must modernized its fighter force the mid-seventies.[19] Roughly a year later, during his last congressional committee prior to retiring, General McConnell declared that there was "still the simple truth that if the other fellow has more and better weapons than you – and the will to use them – then you had better get busy or you are lost."[20] During Secretary of Defense Melvin R. Laird's message to the Joint Session of the Senate Armed Services and Appropriations Committee on February 20, 1970, he stated that the "most formidable technological threat confronting" the United States was the "already large and rapidly growing military-related R&D effort of the Soviet Union."[21] Laird continued that the Soviets continued to outspend the United States on research and development at a rate roughly ten to thirteen percent while the United States remained rather constant, but believed the U.S. remained at a technological lead over the Soviet Union due to its "greater past expenditures."[22]

Through the late 1960s up until the early 1970s, Soviet science and technology continued as a major objective of their national policy with the military establishment a major benefactor as budget allocation to the military remained essentially constant; the key was the allocated percentage stayed constant as the state budget continued to grow. The military threat from the Soviets facing the United States remained both quantitative – the number of Soviet combat aircraft (fighters) exceeding that of the United States; estimated intercontinental-range strike forces delivering more nuclear explosive power than the

Soviet MiG-25 Foxbat.

United States; and, the number of deployed Soviet ICBM's exceeding that of the United States – and qualitatively – systematic improvements in their missile, aerodynamic, space, and military electronics and special weapon system developments.[23] At one point, according to author Dick Hallion, the Soviets produced yearly, over 50,000 surface-to-air missiles (SAM) each year."[24] With these improvements, it was deduced that the Soviets were rapidly achieving a "strategic military balance" with the United States with the Foreign Technology Division at Wright-Patterson AFB reminding General Jack Merrell, Air Force Logistics Command commander, in prep material for speeches in 1971 of the Soviet's announced goal of "military-technological superiority." During General Merrell's speech to the Dayton Area Progress Council, he reminded those in attendance that the United States must "realize that requirements do not remain static" with the weapons of the day not being "optimum tomorrow in the face of the technological and military threat environment." He would respond publicly during both 1971 speeches on the rising Soviet threat that the United States Air Force "must be extremely versatile," that they must not "only possess enough aircraft and munitions for simultaneous deployment to various parts of the world, but also the kinds of aircraft suitable for diverse missions and the ordnance appropriate for striking a wide range of targets…. Weapons must be tailored for specific tasks and must be of differing magnitude for incremental applications."[25]

Along with aircraft revelation at the 1967 Tushino Air Show shocking the West, in 1968, at the height of the Vietnam War, the Soviets and Warsaw Pact forces invaded Czechoslovakia to put an end to the "Prague Spring," a perceived threat to the communist hold on the country. This sudden ease of invasion sent shocks waves into the West with the Soviets abruptly boosting its offensive character in Europe, keeping with "the philosophy of party leader Leonid Brezhnev" of a defense policy with three major goals: build military forces strong enough to defeat the combined strength of potential adversaries; dominate Eastern Europe with both permanent military presence and intervention; and encourage revolution and build communist states.[26]

Acquisition Reform

It was during the 1960s, specifically between 1964 to 1967, that defense spending increased by 5.4 percent annually and reached $236.6 billion (in 1982 dollars) by 1968. Nevertheless, as the deficit grew in the 1970s, defense spending declined by seventeen percent as a share of federal spending while non-defense spending hit record highs.[27] But this did not halt defense spending. During Secretary of Defense Robert McNamara's statement before the Senate Armed Services Committee in January 1968, he remarked that in the more "distant future" the Air Force would "most likely require a replacement" of the McDonnell-Douglas F–4 *Phantom II* along with discussions on the replacement of the Ling-Temco-Vought A–7 *Corsair II* with FY 1969 funds supporting the "preliminary work on the long lead-time subsystems" that the future aircraft would require.[28]

Rollout of the first production F-111A fighter in 1963 (63-9766).

During this same period, the Vietnam War persisted in Southeast Asia and demonstrated early to the fighter community the "unsuitability" of the Century series in air combat against the MiGs in weapons, tactics, and training. Vietnam, as author Dr. Hallion points out, demonstrated that the acquisition of the *Phantom* came just in time as it bore the brunt of air superiority but only had a kill ratio of 3.38 to 1 by the end of the war, mostly due to the unreliability of the AIM-7 radar-guided missile and not the aircraft. In the early 1960s, career Air Force fighter pilots, who cut their teeth during World War II and Korea, had differing opinions from then currently accepted ideas of long-range, low-level nuclear-armed penetrators or multisonic interceptors as well as how the acquisition community were becoming fixated on these airframes, which many felt were unsuitable for real-world air combat. Some engineers pushed the Tactical Fighter Experimental (TFX), which became the General Dynamics F–111 *Aardvark*, with its thrust-to-weight ratio of only .75 but nowhere near what the fighter community wanted or demanded.[29] Some within the fighter community claimed that aircraft were becoming "senile," a "condition in which a weapon [was] not obsolete…. But the threats it faced [were] so great that expensive countermeasures" were having to be taken.[30] Vietnam proved that jet aircraft were vulnerable to antiaircraft fire and surface-to-air missiles, increasing their dependency on electronic protection and suppression.[31] In 1965, Major General Arthur C. Agan, the Air Staff's Director of Plans (and future Commander of Aerospace Defense Command) gathered a team of fighter pilots to conduct a study to argue for a more "maneuverable, agile fighters carrying both missiles and guns" and staffed it to Chief of Staff General John McConnell entitled "Air Force Doctrine on Air Superiority," with General McConnell issuing it throughout the Air Force on May 3, 1965, in part stating: "For air-to-air combat we should seek advantages in such performance parameters as acceleration, climb, maximum speed, ceiling, maneuverability, sighting equipment, and armament ca-

Mr. David Packard, Under Secretary of Defense.

pability." With this endorsement for air superiority and the Air Staff Fighter Mafia[32] rejecting the *Aardvark*, a new generation of aircraft began to grow wings.[33]

Following Vietnam, Tactical Air Command (TAC) set out to address the loss ratio by making huge strides to conduct realistic training for its aircrews to defeat the "hordes of Soviet fighters" that were theorized the United States and coalition forces would face over Europe. The creation of Red Flag at Nellis AFB began by teaching fighter tactics to Tactical Air Command (TAC) personnel against Soviet tactics and then expanded to other commands and coalition forces. This training led to a correlation to greater readiness; however, even the most skilled and motivated pilot required a mission-capable aircraft. Through the mid-1970s, mission-capable rates, either fully or partially, improved to around 70 percent and approached 80 percent during the 1980s.[34]

It is also interesting to note that at the same time, testimony before a congressional committee in 1969 stated that roughly "90% of the major weapon systems that the Department of Defense procures end up costing at least twice as much as was originally estimated." Another analyst testified before the same committee that only two of eleven major weapons systems at the time "had electronic components that performed up to standard." This same year, the General Accounting Office discovered during a survey of thirty-eight current weapon systems that cost estimates were "already 50 percent higher than the original contract figures."[35] It is with this and a need for reform in weapons acquisition, changing perceptions of the military establishment, and views on the United States involvement in Vietnam, that incoming Secretary of Defense Melvin R. Laird received his marching orders to fix defense acquisition. Laird was determined to improve control of cost growth and set out to revise many of Secretary McNamara's programs as the prior years were noted as a period of "better management would solve problems" ultimately translating into "more management with an increase in rigidity, delay, and suppression of initiative."[36] McNamara's approach to acquisition originated from his background at the Ford Motor Company, believing that the "on-paper assessments" were an efficient substitute for costly prototypes; however, this was only the "front end" of the overall acquisition process and thus his Total Package Procurement Concept (TPP) came about. TPP was to provide, during the early period of the procurement cycle, "a competitive purchase of a undesigned system for virtually the entire life cycle of the system." It was under TPP that the contractor was to guarantee the performance of its theoretical design with the intention of absorbing the procurement risk all the while expected to deliver systems on time at the given cost but permitted considerable flexibility in making design tradeoffs.[37]

For his deputy, Laird brought in one of the most successful industrial managers to help with acquisition reform, David Packard, from Hewlett-Packard. Packard wasted little time by moving away from a tightly controlled military management style to a "system in which overall objectives were clearly stated and agreed upon" and giving individuals "the flexibility to work toward those goals in ways they determine best for their own areas of responsibility." Packard accepted the challenge to reverse McNamara's Total Package Procurement (TPP) approach, which combined both system development and production of the weapon system into one contract and create a system more responsive with "additional production-ready options for future decision makers." McNamara's TPP approach eliminated competition early in the acquisition process that restricted options while at the same time encumbered DoD with "an incredible amount of risk by committing production contracts to designs that only existed on paper."[38]

Share of the blame on acquisition programs under TPP fell on both the services and contractors due to contractors having little incentives because of the absence of competition for production contracts and the services allowing contract changes and not enforcing the fixed-price of the contracts for fear of further delays. Even more importantly, TPP failed to allow industry any opportunity for significant redesigns before production began.[39] Packard's challenge lay in unifying all the stakeholders within the military-industrial complex as well as shifting the focus of politicians and the defense industry from Vietnam back towards the Soviet threat. In May 1969, Packard took the first step in modifying the defense acquisition practices at the highest level by creating a new organization that advised him on the "status and readiness of each major system" and its readiness for the next phase in its life cycle. This new organization, the Defense Systems Acquisition Review Council (DSARC), advised Laird and Packard on major weapon systems progress at critical decision points. DSARC, formed in May 1969, created three progress milestones for acquisition programs that intended to "enhance" the acquisition process – program initiation decision, full-scale development decision, and production decision. Packard's logic for reforming the acquisition process was two-fold: es-

General James Ferguson, Commander, Air Force Systems Command .

tablish a decision point within the Office of the Secretary of Defense (OSD) to "ensure its integrity and increase the number of programs pushed into hardware development by fully utilizing advanced prototyping initiatives." With this, programs needed to establish various milestones within the development and test schedules with "step-by-step achievement" of the objectives to "guard against technical surprises and demonstrate program progress."[40]

One key to Secretary Packard's acquisition reform was prototyping. In the late 1960s, prototyping gained a new appeal as it addressed Packard's acquisition reforms with its "promise to reduce – even minimize – the technical risks in new programs" and believe it could help avoid time and cost as technical problems surfaced once the new system was in production. Many considered this a "new" concept in the late 1960s because it had fallen out of favor for nearly a decade as it had been deemed an unnecessary expense at the beginning of the 1960s with the theory that accomplishment of aircraft selection could be based upon paper analyses, brochure competition, and statistical evaluation with hardware demonstrations replacing prototyping.[41] However, some supported prototyping with a RAND Corporation study in February 1963 urging prototyping "particularly where large technological advances are being sought" and five years later in another study stating that it was "sensible to build and fly a prototype of an aircraft before finally deciding to produce it in quantity." Later in the year, President Lyndon B. Johnson's special assistant for science and technology, Dr. Donald F. Horning, pondered if "putting more emphasis on prototype development before deciding about production" would alleviate acquisition issues. As 1968 closed out, during a lecture in London, Mr. George Schairer, of the Boeing Company, stated "Paper competitions assume that people can get smart by studying. Prototype competitions add that very great increment of smartness which can be learning only by doing." General James Ferguson, Air Force Systems Command commander, supported Secretary Packard's push for prototype competitions as he wondered if prototypes had been more expensive "in the long run" with some industry officials and financial analyst believing that huge sums of money were utilized in building prototypes with no guaranteed return on investment but Ferguson believed that prototype competitions added a "degree of confidence" to the production decisions "as well as a predictable reduction of technological risks in acquisition programs." Ferguson advocated source selection as it could "be based on a hundred cubic feet of hardware rather than a hundred cubic feet of paperwork.[42] Packard felt that the long-term advantages of prototyping allowed more "flexibility and certainty" which gave contractors the ability to "build and test a real piece of hardware not only gave assurance the design would demonstrably perform, but also meant better estimation of follow-on costs." The old practice of cost estimating, he felt, was "wishful thinking" and "encouraged the ruse of parametric costing, combined with prototyping, to reduce overrun risk."[43]

By the end of the 1960s, prototyping re-entered, as it had been done during the 1930s and 1940s and called "Try-Before-Buy", into the acquisition lexicon as well as other parts of Secretary Packard's reform movement as new computers and manufacturing technologies helped enhance acquisition process but fiscal austerity and inflation in the 1970s undermined programs.[44] This fiscal austerity began in the late 1960s in Vietnam and saw no end in sight along with pending defense cuts on the horizon placed a daunting task for the U.S. military to shift focus away from Vietnam and back against peer competition with cost, schedule, and performance within the acquisition process becoming vital. It is with this in mind that Secretary Packard created his acquisition reform movement that "fostered, facilitated, and incentivized innovation within the fiscally austere, cost-conscience budget landscape."[45]

Secretary Packard's reforms looked to decentralization of program management by strengthening the system project offices by giving the system program directors (SPD) "full system configuration authority and by providing him the procedures which enhanced the control of the system's flow through the acquisition phase of its life cycle." One procedure that was made available and institutionalized with the SPDs was the Blue Line Reporting System, which gave SPDs of a weapon system "direct access to the Chief of Staff and Secretary of the Air Force." This allowed direct communication up or down for "rapid and direct system decision making." Program Assessment Reviews (PARs) and Command Assessment Reviews (CARs) provided opportunities for SPDs to delineate program progress and problems up the chain to ensure "close attention to cost tracking and control" of the individual weapon systems. In 1973, AFSC instituted the Field Assessment Review (FAR) to inform the Commander of a review of resources and activities within AFSC's test and evaluation organizations as well as a Management Assessment Review (MAR), similar to PARs/CARs, that looked at non-Par/Car programs.[46]

Secretary Packard's new acquisition processes met with some resistance to his focus on "cost as king" and his

efforts to streamline reporting channels between OSD and program offices within AFSC. In September 1970, General George S. Brown assumed command of AFSC and believed that the F–15 program office was locked "out of an awful lot of possible help" from AFSC. General Brown believed that program managers had "certain responsibilities" to the AFSC commander, and it was AFSC's responsibility to "deliver performance and operational capability…and getting the system within the schedule." In January 1971, Brown met with Secretary Packard demanding the authority, the resources, and minimum staff interference to "identify losers as soon as possible and divert the funds to likely winners" and stated that he would notify Packard "about it after we've done it" as well as ask if he ever needed help. Packard saw no issues with Brown's requests stating that if he saw something that was not going well, "cancel it" and to "periodically let me know how things are going." Packard's push to improve decision-making ability and away from McNamara's "tight grip" on the services by delegating authority down to the lower levels had ruffled senior leaders with General Brown not consenting to program managers risking schedule and performance requirements to attain cost goals.[47]

Yom Kippur War and Ramifications for the U.S. Air Force

Fourth in a series of major Arab-Israeli conflicts that followed the formation of the Israeli state, the Yom Kippur War followed two preceding conflicts – the War of Independence in 1948 and the Six-Day War of 1967 – that lead to clear Israeli victories. The Six-Day War was one-sided where the Israeli Air Force (IAF) commenced preemptive attacks that devastated their Egyptian counterpart in a single morning with Israeli combined armed forces sprinted to victory, taking substantial areas of Egyptian and Syrian territory as well as capturing the Jordanian West Bank and sole possession of Jerusalem.[48] The Yom Kippur War provided important lessons for future conflicts and "constituted a microcosm of the kinds of issues that might be involved in a high-technology war of movement in Europe."[49]

Following the Six-Day War, periodic fighting along the Suez Canal resulted in the building of the Bar-Lev defensive line during the late 1960s by the Israelis. This in turn triggered Egypt into launching attacks, known as the War of Attrition, lasting until August 1970 consisting of artillery exchanges, commando raids, and aerial battles. The IAF developed familiarity with modern air defense systems but faced losses despite the supply of American electronic countermeasure (ECM) equipment. Despite these losses, the Israeli military emerged from the War of Attrition with their military reputation unharmed. After the Six-Day War, the IDF received shipments of Douglas A–4 *Skyhawk* and McDonnell Douglas F–4 *Phantom II* jets from the United States as well as other weapons to modernize. To defend against these modernization efforts, both the Egyptians and Syrians employed an expanding number of Soviet-supplied SA-2, SA-3, SA-6, and SA-7 missile systems in the

Israeli Air Force during the Yom Kippur War. ***(Wikipedia Commons).***

Suez Canal region as well as received MiG-21 *Fishbeds* and MiG-25 *Foxbats*.[50]

The timing and extent of the attack by Egypt and Syria on the afternoon of October 6 – the holiest day on the Jewish calendar and during the Muslim holy month of Ramadan – caught Israel by surprise with the IAF scrambling to support embattled ground forces from the massed formations of Egyptian armor and infantry assaulting across the Suez Canal. Unbeknown to the Israelis was the extent the Soviets had equipped the Egyptian and Syrians with air defense equipment since the end of the War of Attrition that created an impenetrable SAM "umbrellas" that "shielded Arab forces from Israeli Air Force attacks on both fronts."[51] The Egyptian air defenses were the "most elaborate ever constructed" on a scale "not witnessed since" World War II with the equipment levels, troop proficiency, leadership, and logistical support significantly increased along with the incorporation of wide-ranging innovations since the Arabs' last defeat.[52] During the late 1960s through the early 1970s, the Soviets had greatly improved its battlefield defenses, which would be highlighted by the air defense systems implemented by the Arabian forces and the lack of the Israeli *Skyhawks* and *Phantoms* to detect SA-6s operated by the Egyptians, downing the majority of the 96 IAF aircraft lost during the war.[53]

Through Israeli determination and skill, Arab blunders, U.S. materiel support slowly turned the tide. As the Soviets continued to actively supply weapons to

Israeli Air Force during the Yom Kippur War. ***(Wikipedia Commons).***

The first MAC aircraft to land at Lod Airport, Israel, was C–5 (4061) assigned to the 60 MAW at Travis AFB, Calif. Operating in a "dark window" schedule, the C–5 landed at Lod at 2201Z hours on October 14, with 93.1 tons of military aid for the Israeli Defense Forces.

Egypt/Syria, U.S. Secretary of State Henry Kissinger decided that the United States could not afford Soviet aid to allow the Arabs to defeat Israel. Further, Kissinger held firm that the United States could not afford an adversarial win over a U.S. ally and by sending arms to Israel, the United States could ensure an Israeli victory, hand the Soviets a defeat, and provide some influence over a postwar settlement. On October 13, President Richard Nixon[54] ordered the resupply of Israeli forces. Known as Operation NICKEL GRASS, the airlift included large quantities of equipment and weapons along with the delivery of combat aircraft from frontline units to IAF squadrons. On October 24, the Soviets threatened to intervene in the fighting with the Central Intelligence Agency reporting that the Soviets had stopped airlifts to Egypt but preparations to switch from weapons to troops were beginning. In response, Nixon placed the U.S. military on alert, increasing its readiness for the deployment of conventional and nuclear forces. It was also during this period that President Nixon faced the Watergate Scandal, with some theorizing that he utilized the Soviet's response in the war to divert attention away from the scandal, but the danger was real and probably the closest the two superpowers ever came to nuclear war other than the 1962 Cuban Missile Crisis. The Soviets, however, never sent troops and U.S. forces were taken off alert. Now resupplied, the Israeli military forces countered successfully and took advantage of Egyptian and Syrian mistakes, advancing past the original positions on both fronts by the ceasefire declared on October 24.[55]

Despite IAF's accomplishments, it was their experiences and especially their struggles against the Soviet-supplied air defenses that drew the most analysis in the war's aftermath. The IAF lost roughly 100 aircraft in less than three weeks of fighting and struggled to make a presence on the ground battle. At the wars end, it seemed that the future of tactical air power was in doubt with some believing that the "missile [had] bent the aircraft's wing," however, from the U.S. Air Force's perspective, the Soviet missiles were "bending," or downing, American-supplied aircraft.[56] The IAF had repeatedly defeated the Arabs' attempts at establishing a credible air defense system and only weeks prior to hostilities baited and ambushed Syrian interceptors, downing 19 aircraft. The IAF was surprised by the effectiveness of the Arabs' proficiency in operating the Soviet-supplied air defense systems without advisers. The old electronic countermeasures were unable to jam the radar acquisition and tracking frequencies of the SAM-6 and flares were ineffective against the "optically-aimed, heat-seeking" missiles.[57] The IAF did not crack the air defense cover on the Egyptian front until Israeli tank units physically overran the SAM and AAA sites on the West Bank on the night of October 15-16 . Then the IAF was able, in coordination with ground forces, to defeat the air defense systems.[58] This worried defense analysts considering future NATO combat against Warsaw Pact forces. Hypothetical plans for war in Europe relied heavily on armor and aircraft that were vulnerable to new enemy weapons and now had to factor in high rates of attrition and materiel resupply with NATO forces needing to replace battle losses on an unanticipated scale; attrition and consumption rates along with the ability of a modern ground-based air defense contesting the control of the air now became key concerns to planners.[59]

During a speech to the Squadron Officers School at Maxwell AFB on November 28, 1973, retired Lieutenant General Ira C. Eaker stated that the Arab forces, equipped with the "latest Russian weapons, of the same quality with which Russian front-line divisions are equipped," confronted American-built aircraft with Soviet-made missiles had shown once again the criticality of air superiority in warfare. The IAF "struggled to impose itself over ground battles fought in SAM-defended zones" with Israeli ground forces suffering high losses.[60] Chaim Herzog, a career soldier and later president of Israel, stated that the "role of the plane in war has changed…. To a degree air power will not be as influential as it has been and will affect the battlefield less than it did."[61] The International Institute for Strategic Studies noted that the war showed "how effective an air-defense umbrella over ground troops can be, so the heavy Soviet air defenses in Europe clearly have to be reckoned with….There is no likely to be great emphasis placed in the West on the development and deployment of…missiles to suppress air defenses. Weapons which, because of their accuracy, increase the probability of a single-shot kill, thus reducing munitions expenditure and aircraft sortie rates (and hence vulnerability) will attract increased attention as a result of this war."[62] Technology now would be key in either winning or losing as Giora Ram, an Israeli *Skyhawk* squadron commander noted in October 1973: "[The outbreak of the war] witnessed one of the watersheds in the history of the air force: technological inferiority. Technological superiority had been one of the cornerstones of the Israeli Air Force, and in 1973 the air force had to make a great effort to close the technological gap created by a new type of [threat]…. We [had] entered the war at a technological disadvantage."[63]

Soviet-supplied SA-2 surface-to-air missiles deployed to Egypt during the Yom Kippur War.

Following the ceasefire on October 24, the U.S. Air Force participated in several joint and discrete military fact-finding activities. One of which was the United States Military Operational Survey Team (USMOST) directed by Secretary of Defense James R. Schlesinger to identify lessons learned. Admiral Thomas H. Moorer, Chairman of the Joint Chiefs of Staff, outlined the purpose of USMOST as "determining first-hand the operational lessons" from the conflict with lessons learned being "invaluable in our constant effort to maintain the best possible defense posture against potential enemies."[64] Specific to the Air Force, the team was to look at the IAF's coordination between air and ground forces during close air support and air defense missions, the employment of the AIM-7 *Sparrow* and AGM-65 *Maverick* missiles, SAM suppression and effectiveness of countermeasures with specific emphasis on the SA-3, SA-6 and SA-7 systems, electronic warfare, and lessons regarding command, control, and communication.[65] Another team, the U.S. Military Equipment Validation Team, Israel, or USMEVTI, arrived before USMOST to "determine weapons effectiveness data as available from tank/equipment carcasses and field visits" with the directions to work together with USMOST, transferring and supplementing information and avoiding duplication of efforts.[66] The U.S. Air Force also participated indirectly via political initiatives as a "chaperone" during a visit of the subcommittee of the House Armed Services Committee to the Middle East in November 1973. Major General Marion L. Boswell accompanied the congressmen on their visit to Israel as well as Egypt to "meet with National decision makers, discuss tactics and weapons with military leaders, and to observer first-hand the impact" of the war.[67]

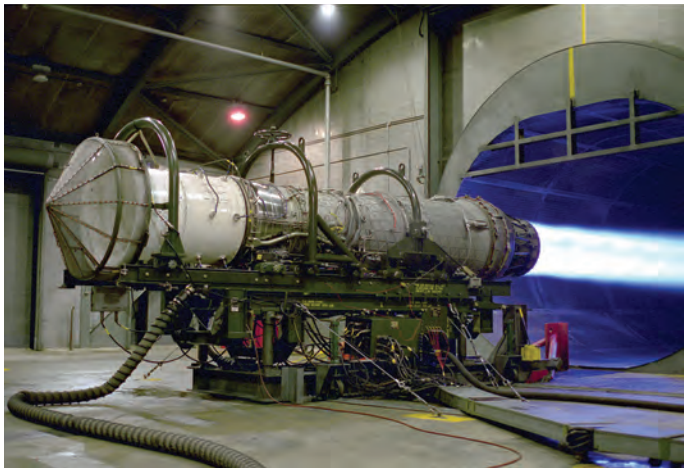
Along with these various visits to Israel, the Air Force also took various service initiatives as well. On October 30, 1973, John L. McLucas, Secretary of the Air Force, suggested that the Air Force Policy Council meet to discuss the lessons learned. It was agreed that analysis would be incomplete but McLucas was keen to safeguard "the planning and budgetary process promptly…in such areas as R&D, weapons acquisition, basing, training, deployment, employment, and intelligence."[68] At the same time, Lieutenant Colonel Charles A. Horner[69] in the Directorate of Operations, produced two key talking papers in November – "Mid East War Data Support of USAF Programs" and "Interdependence of Air and Ground Operations" – that interpreted the conflict and drew conclusions with long-term relevance.[70] It was the Yom Kippur War that led to the U.S. Air Force's efforts to innovate against the expanding IADs threat in the mid-1970s with the Pave Strike initiative with the purpose to preserve the capability of strike aircraft against the increasing and involving threats in Eastern Europe.[71]

It was obvious through analysis of the Yom Kippur War that the Air Force would need to assume high levels of materiel attrition and munitions employment in a modern conflict. Discussions on quantity played into discussions regarding the optimum high/low force balance proposed between new weapons systems and it became clear that not only would a capable aircraft be required but also numerous "quantities of consumable stock – an important observation as the U.S. military contracted in 'normal' post-war fashion after the end of its involvement in Vietnam."[72] The Yom Kippur War contributed to the adoption of an "offset strategy" by the U.S. during the 1970s.[73] This strategy pursued "leap-ahead technologies to offset Soviet superiority in Europe."[74] As the United States Air Forces in Europe (USAFE) Director of Intelligence in 1973, then Major General Wilbur L. Creech had access to the latest intelligence on the modern Soviet SAMs being used during the Yom Kippur War as well as the first-hand accounts from the IDF pilots against them. Creech believed that once the SAMs were degraded that operations could adjust and then utilize precision munitions, leading to air defense rollback, his central vision of air superiority.[75] In his 4 March 1974 report to Congress, Secretary of Defense James R. Schlesinger stated that the "tactical air forces [were] not only a great investment of national resources" but "also a most essential element in our national defense strategy." He would go on to state that the tactical air forces were depended on to "offset…possible numerical inferiorities in land forces as compared to potential adversaries."[76] However, during the early-to-mid-1970s, planners anticipated a conflict in Europe and worried about defending the West from a Soviet "blitz through the Fulda Gap," which according to author Dick Hallion, "distracted American and European nations from more likely conflicts in traditional hotspots."[77]

Packard's Processes Put into Action to Build a New Air Force – A Review of Select Programs

F–X Fighter-Experimental (McDonnell Douglas F–15 *Eagle*)

When secretaries Laird and Packard entered the Pentagon, they believed that the cost overruns on the F–X were caused by TPPs lack of program supervision once a contract was signed with Packard insisting on the establishment of a new "milestone" process to monitor developmental and production costs and "fly-before-you-buy" or



Pratt & Whitney F100 engine during testing.

Brigadier General Benjamin N. Bellis (far left), deputy for the F–15 program, discusses the F–15 model with (left to right) Secretary of the Air Force Robert Seamans; General James Ferguson, commander of Air Force Systems Command; and Lieutenant General James Steward, commander of Aeronautical Systems Command.

prototyping. Air Force Systems Command explained to Secretary Packard that it had considered a form of prototype fly off with the F–X but discovered it was too complicated and cost nearly $6,000,000; utilizing data from twenty-two different prototype programs from the past, it was determined impractical for the advanced F–X. Nevertheless, Packard insisted on prototyping for the engine and radar as well as for all future major programs.[78] A month before General Agan's memo, Air Force Systems Command began studies for a new tactical fighter, coming up with the "Preliminary F–X Concept Formulation Package" in September 1966 in which Major John Boyd rejected it in October.[79] It took the following June before a final concept was agreed upon and another year before a request for proposal (RFP) on the airplane, its pulse-doppler radar, and engines was issued. On September 30, 1968, eight manufacturers received the RFP with four responding and three narrowed down by December: McDonnell-Douglas, North American-Rockwell, and Fairchild. On December 23, 1969, the Air Force selected McDonnell Douglas the winner of the F–X and designated it the F–15 *Eagle,* and contracting the company for an initial twenty aircraft for developmental testing with DoD supplying Pratt & Whitney engines. Until the *Eagle* met the technical milestones, commitment to production would be deferred. The Air Force utilized a cost-plus-incentive-fee (CPIF) contract that covered design, development, test, and test support whereas a fixed-price-incentive-with-successive-targets (FPIS) contract covered the test aircraft, test support equipment, spare parts, and ground support equipment to support the test program along with the first production of the first 107 aircraft fell under the FPIS contract. Passing the critical design review in April 1971, the *Eagle* made its first flight on July 27, 1972.[80]

While the F–X airframe itself did not go into prototyping competition, two key components of the F–X would be the radar and engine. The Hughes AN/APG-63, pulse-Doppler radar, with a "look-down, shoot-down capability" that could track multiple targets at long or short range, won the competition for the radar but after a very competitive and close competition for the engine, the Pratt & Whiney F100 engine was chosen over the "lighter and structurally superior" General Electric 401 due to what was "considered higher risk." Due to the technological advancement and the critical linkage to the *Eagle's* performance, the contract Pratt & Whiney entered had several milestones the F100 had to meet with one being a satisfactory Military Qualification Test that included a 150-hour endurance test, as well as a clause within the contract stating that Pratt & Whiney had to correct, at their expense, "any subsequently discovered deficiency stemming from its design, workmanship, or material."[81] The goal was to get the F–X selection process completed and into production as quickly as possible but many within the Air Force blamed OSD for the forced delays, nevertheless, the careful review of the program as it moved along allowed the "technology of the F–15 to develop more fully."[82] Of note, by early 1973, wind-tunnel test hours reached nearly three times that of the entire F–4 program mainly due to the lessons learned from the F–111 experiences, looking intensively at potential engine-inlet compatibility issues. By the end of 1973, airframe fatigue tests equated to four lifetimes. The flight test program progressed at a faster pace than in previous jet aircraft development. Information from these tests resulted in timely design changes with fatigue test failures leading to wing spare modifications and flight tests leading to changes in the variable-geometry engine inlet ramp sensitivity, control stick force, and flight control system.[83]

Testing of the *Eagle* proceeded accordingly and met all its performance milestones on or ahead of schedule apart from engine qualifications. Plans were initially laid out with the first procurement of 30 funded in FY 1973, another 62 funded in FY 1974, and the FY 1975 budget included $183 million for R&D and $893 million for the third procurement of 72 with the remaining 565 scheduled in FY 1976 through 1980.[84] Program costs initially projected at $6 billion in September 1968 would climb to $7.3 billion by February 1970 with Secretary Laird pointing to "bad estimates at the initial planning stage" as well as very high

First flight of the F-15A prototype at Edwards AFB, California.

YF-16, winner of the Lightweight Fighter competition

inflation rates of the mid-1970s affecting perhaps the "largest single element of the F–15 program cost growth." Nevertheless, Laird pointed out in 1970 that the *Eagle* was proceeding on schedule with a projected allocation of $370 million in FY 1971.[85] However, the procurement rate did not work out this way and the initial acquisition was stretched out to nine years, adding two billion dollars.[86]

F–XX/LWF Lightweight Fighter
(General Dynamics F–16 *Fighting Falcon)*

Before the *Eagle* getting off the ground, Major Pierre Sprey stated that there were four criteria for an air-superiority fighter, in order of importance: "first, obtain the first sighting; second, outnumber the enemy in the air; third, outmaneuver the adversary to gain firing position; and, finally can achieve split second kills." Sprey and others believed the *Eagle* was "too large to achieve the first, third, and fourth" and became too expensive to purchase in the numbers that the second required. This debate generated other questions with the central question of "should American fighter design be driven by the eternally optimistic theory that sophisticated, that is, more complex, technology [would] negate the effects of being outnumbered," or evolve away from "combat-drive criteria" requirements and build greater numbers of "less complex aircraft."[87] A group of individuals within the Fighter Mafia began their descent away from what they felt was just "another big, fast sled" before the *Eagle's* first flight and began championing a lighter, single-engine, more agile, air superiority fighter at low-cost, to fit within the decreasing defense budget that they dubbed the F–XX, later known as the Lightweight Fighter (LWF). Majors John Boyd, Pierre Sprey, and Col Everest Riccioni pushed the F–XX as an alternative to the *Eagle* but found little sponsorship within the Pentagon as Secretary of Defense James R. Schlesinger, in his message to the House Armed Service Committee on March 4, 1974, stated that the *Eagle* was to be the first fighter "specifically designed to excel in air-to-air-combat." He would go on to state that it was armed with the newest air-to-air missile system and an improved close-in air-to-air missile system, making it "superior to any fighter the Soviet Union was likely to deploy in the next 10-15 years."[88] However, supporters of the F–XX found promise after the Aeronautical Systems Division study "Application of the Theory of Energy Maneuverability to Fighter Aircraft Design" that favored the F–XX as well as President Nixon's "Blue Ribbon Defense Panel"[89] report in June 1970 and Deputy Secretary of Defense David Packard establishment of "fly-before-buy" competitive prototyping process that leaned towards the

John Boyd, member of the Fighter Mafia.

Boeing's Lightweight Fighter Concept, later known as the YF-16.

F–XX. In February 1971, Secretary Laird agreed to the Simon Study[90] that examined the potential of utilizing the F–XX within Secretary Packard's prototyping program. At the same time, as Riccioni prepared to leave for his assignment to Korea, he received funding for a study on the F–XX and passed the money to both General Dynamics and Northrop to "design a 25,000-pound fighter whose performance would be superior to the F–4." The study soon leaked to other contractors who immediately offered unsolicited proposals for the F–XX to the Air Force; Boyd and Riccioni visited Boeing when the contractor failed to submit a proposal and heavily urged them to submit, which they did. Packard recalled later that it was "impossible to make sense of what the problem was" and brought together "pilots from Vietnam" for discussions on the F–XX proposal. It was with "fly-before-you-buy" prototyping that Boyd and Major John "Mike" Loh in September 1971 realized the opportunity to push the F–XX, eventually the Lightweight Fighter (LWF) Program, as a technology demonstration to evaluate two alternative designs, the YF–16 and YF–17.[91]

The Simon Study was the outline utilized to prepare the RFP for those to compete for the LWF contract where two companies would be selected and given 100 million dollars each to build a prototype for the fly off with each company given a wide latitude in their development of the new fighter; selected on April 13, 1972, General Dynamics and Northrop began efforts on their respective prototypes for the fly off with the YF–16 prototype rolling out of the General Dynamics Fort Worth facility on December 13, 1973. However, not everyone was on board with the LWF. As Chief of Staff of the Air Force, General George S. Brown was very cautious as Secretary of Defense James R. Schlesinger reflected years later: "He really tore the idea of the F–16 apart, preferring to stay with the F–15 [as] I was pushing for the development of the F–16."[92] On January 13, 1975, General Dynamics received an FPIF contract for the production of 15 engineering development YF–16 – 11 single-seat and 4 two-seat versions. In January 1978, it was announced that the YF–16, with the same Pratt and Whitney engine as the *Eagle*, won the fly-off with Robert Coram writing: "the YF–16 was the unanimous choice of pilots who flew both aircraft…[because] it could flick from one maneuver to another faster than any aircraft they ever flew…the most nimble little banking and yanking aircraft the world have ever seen." Packard remarked later in his memoir that the F–16 became the "best Air Force fighter plane"[93] with fighter pilot confirming that the F–16 was everything that he had been looking for, stating that it was "an F–4 writ small, not writ large like the F–15."[94]

A–X Close Air Support
(Fairchild A–10 *Thunderbolt II*)

Some might say the most significant acquisition move Secretary Packard made came in January 1970 when he ordered the Secretary of the Army and the Secretary of the Air Force to resolve the close air support (CAS) debate and develop a "unified DoD position" with an agreement between the two secretaries coming two months later to move forward on the A–X program. Secretary Packard recognized that it was more efficient that a compromise be reached through the two service secretaries rather than attempt to "strong-arm" the service chiefs. Dr. Robert Seamans, Secretary of the Air Force, remarked that both he and Stan Resor, Secretary of the Army, agreed that "a fixed-wing, close-support aircraft, the A–X was probably needed, and that the Air Force should be responsible for its development.[95] In April 1970, the approval for the A–X concept for prototype development with the final RFP issued in May to twelve companies with six responding and the Air Force selecting Northrop and Fairchild to build prototypes for the competitive fly-off by December; the A–X's primary weapon, the GAU-8 30mm Gatling gun, RPF released on November 16 and in June 1971 entering into a competitive prototype competition between General Electric and Philco-Ford Corporation. The A–X would be the first air-

The Northrop YA–9A prototype in flight at Edwards AFB, California, loaded with BDU-33s in 1973.

First flight of the Fairchild-Republic YA–10 at Edwards AFB, California in 1972.

Lockheed F-117 Nighthawk taking off at Tonopah Test Range, Nevada

craft, under Packard, to be built under his new "fly-before-you-buy" program. By the summer of 1972, the Northrop YA–9 and Fairchild YA–10 completed 284 flight test hours with the YA–10's first flight on May 10, and then twenty days later the YA–9 took its first flight. In January 1973, Secretary of Air Force, Dr. John McLucas, declared Fairchild the winner and contracted to reproduce ten test aircraft. In March, officials contracted General Electric to develop and deliver 32 TF–34 engines over the Avco Lycoming F102. On June 21, Secretary McLucas announced the award of a developmental contract of the GAU-8A to General Electric under a Fixed Price Incentive (Firm) contract for three preproduction systems.[96]

Despite this quick movement on a solution for CAS, in July 1973 the Senate Armed Services Committee cut the FY 1974 request for A–10 preproduction aircraft down to six as well as recommended a flyoff between the YA–10 and the LTV A–7D *Corsair*. Between April 15 and May 9. 1974, the YA–10 and A–7D conducted a joint comparative flight evaluation test at Fort Riley, Kansas, nicknamed Saber Compare, where the YA–10 was declared by OSD to be the more effective aircraft. The A–10s slower speed allowed it to keep the target in sight, stay closer to the target with its maneuverability, and allowed it to attack several times quickly. The following year, Deputy Secretary of Defense William P. Clements Jr authorized the Air Force to proceed with the initial production of 52 aircraft. On October 21, 1975, the first production A–10 flew from Fairchild's Farmingdale, Long Island plant.[97]

Stealth
(Lockheed F–117 *Nighthawk*)

Lessons learned from Vietnam and following the Yom Kippur War, low radar cross section (RCS) projects gained traction when survivability became a critical focus and individuals believed that to defeat an enemy's air defenses was to "minimize the radar and infrared signatures of an aircraft by careful attention to shaping, use of radar-absorbent materials, and use of 'cool' two-dimensional sheet-like exhausts."[98] Beginning in October, the Defense Department and various research agencies directed several studies in response to the challenges it perceived. In November 1973, the Science Advisory Board met with Tactical Air Command personnel at Langley AFB to discuss the topic of aircraft survivability.[99] A study completed during the summer of 1974 by the Defense Science Board took the results from the Yom Kippur War and extrapolated them onto a European scenario and concluded that "U.S. and NATO air forces would be decimated in a general war in as little as two weeks."[100] Following the study, Dr. Malcolm Currie, Director of Defense Research and Engineering, instructed the hunt for "radical new ideas" that would overcome the air defense problem.[101] With Air Force sponsorship, DARPA proposed a "high stealth aircraft" that represented "a silver bullet…that could blow a hole through [Soviet] defenses."[102] DARPA issued a Statement of Work for a "High Stealth Aircraft" study that emphasized "the… design of tactical aircraft possessing maximum stealth through the minimization of radar, IR, visual, and acoustic signatures."[103] The low RCS feasibility study went to five aerospace companies – Northrop, McDonnell Douglas, General Dynamics, Fairchild, and Grumman.[104] In April 1977, Lieutenant General Alton Slay, Deputy Chief of Staff for Research and Development at Headquarters USAF, chartered the SENIOR HIGH[105] program with the initial cadre studying the "technology's possible influence on deterrence." Ultimately, it was Lockheed that developed the concept air platform, "Have Blue," and in October 1978, the Air Force issued the Skunk Works a contract to build the F–117 itself with the first flight scheduled for July 1980, reaching Initial Operational Capability (IOC) quickly by December 1982. In December 1978, Lockheed received authorization to begin production at roughly the same time that program management transferred from Air Staff to the newly created Systems Program Office (SPO) for low

Second flight of the Rockwell B–1A Lancer.

observables with the Aeronautical Systems Division at Wright-Patterson.[106]

Rockwell B–1 *Lancer*

Application of Packard's acquisition processes was demonstrated with the Rockwell B–1 *Lancer* even though it was not anticipated to produce a sufficient volume of orders to warrant a full prototype competition. Packard believed in simplifying the RFP as the "important first step" as was practiced with the Lightweight Fighter, where the source-selection process was dramatically shorted with the establishment of the length of the proposal and changing the scoring system.[107] The RFP for the new strategic bomber was released in November 1969 and almost immediately felt the presence of Packard as the originally proposed RFP was believed to be "one of the largest paper monsters ever produced." Packard himself reviewed the document and removed significant amounts of what he felt were unnecessary wasteful requests. Packard adhered to paperwork, citing one project that crossed his desk as "paperwork accounting for 30% of the program's total cost." With the *Lancer* RFP, Packard wanted those involved to take a hard look at the precise detail within the RFP, expounding how the draft stated the "contractor would have had to go through this big exercise on how he was going to do all" of a particular item when he should be "allowed to direct his full attention to making a better airplane." Packard believed that "all the detailed paperwork that needs to be done" could be accomplished at the "appropriate time."[108] On June 5, 1970, Dr. Robert Seamans, Secretary of the Air Force, announced the selection of North American Rockwell and General Electric as winners of the airframe and propulsion contracts. Packard's "fly-before-you-buy" approach was taken with the cost-plus-incentive-fee (CPIF) contract signed for only the engineering development of the B–1 with Rockwell to provide five flight test aircraft, one static test airframe, and one fatigue test airframe (later reduced to just three) while General Electric was separately contracted to develop and build 40 "preliminary-flight-rated-test" engines (later reduced to just 27). During this time there was no avionics contract awarded and no authorizations on production. Eventually, avionics split into two packages with Boeing selected to integrate offensive avionics into the B–1 in April 1972 and Cutler-Hammer contracted in January 1974 for the defense avionics system.[109] Secretary Packard affirmed to Dr. Seamans that this authorization of the B–1 was for development only, and that a decision on "whether the B–1 will be authorized for production, when production might be authorized, or what level of production will be authorized" had not been made.[110] Approval for production would not come until the Reagan administration, followed through on a presidential campaign promise; however, Research, Development, Test, and Evaluation (RDT&E) had funding kept the flight test program ongoing and allowed continued maturity of component technologies until full-scale development and contract awarded of Lot 1 production in January 1982. Between the first flight of the B–1A in December 1974 to April 1981, the four prototypes "accumulated 1895.2 flight hours, more than 25,000 hours of wind tunnel testing, and the structural article had been subjected to fatigue testing designed to simulate three aircraft lifetimes" as well as included the dropping of roughly 60 B61 inert nuclear weapons and two missiles.[111]

Foreign Military Sales (FMS)

Both the Nixon Doctrine and Vietnamization, withdrawing U.S. forces and transferring the responsibilities to South Vietnam, involved shrinking United States worldwide commitments from a two-and-a-half posture to a new one-and-a-half posture, a strategy that relied heavily on foreign military sales (FMS) to U.S. allies. On April 14, 1970, Secretary Packard addressed a crowd in St. Louis concerning these impacts on defense spending, DoD workforce, and policies abroad, noting that for the first time in twenty years the shift in government spending away from defense spending and towards domestic programs. In August, when asked by the media if there could be even more cuts following the ramping down of Vietnam, Packard warned that the United States "must keep our military capability up, because the world is no less hostile just because we are withdrawing from Vietnam" and he warned that the world could be growing even "more hostile" due to the "growing danger in the Mideast" and the "heavy defense spending" by the Soviets.[112] During this same timeframe, the U.S. saw a shift in support to our allies with just nearly seven billion expended between 1966 to 1969 but a 40-percent increase between 1970 to 1973. During the Israeli-Arab wars from 1967 to 1973, the Soviets increased their aid to Egypt and Syria, including the establishment and operation of an air defense system in Egypt, and as the war unfolded between March 1969 to August 1970 along the Suez Canal, the U.S. felt obligated to increase their aid to Israel from $40-million-a-year for three years post the Six-Day War to $400-million-a-year after, nearly 28-percent of Israel's total defense spending.[113] However, this region

Egyptian F-16s.

Headquarters Air Force Systems Command, Andrews AFB, Maryland.

would be constantly changing and in 1979, the U.S. and Egypt signed a letter of offer and acceptance for the sale of 40 F–16A/B aircraft under the name of PEACE VECTOR to modernize the Egyptian Air Force and demonstrated the United States' willingness in providing Egypt with similar equipment provided to Israel, known as PEACE MARBLE. Similar foreign military sales took place in the mid-to-late 1970s.[114]

During President Nixon's 1972 State of the Union Address, he stressed his Realistic Program of Foreign Assistance, which included provisions for loans and grants-in-aid, foreign military sales (FMS), military technology licensing, and technology transfer to key allies. A few years prior, during Secretary Laird's message to Congress on the FY 1971 Defense Budget in February 1970, he noted that due to the Nixon Doctrine, the defense budget percent of the GNP would drop to 7 percent, down from 9.5 percent in FY 1968 with the passing comment that DoD was "looking for a new 'International Fighter' for NATO and its other allies," those individuals that, under the Nixon Doctrine, "would be taking more responsibility for their own defense." This pledge was reflected in the DoD FY 1973 Annual Report which Secretary Larid pointed out that for the "first time, planning for military assistance and credit sales took place." Secretary of Defense Elliot Richardson, in April 1973, pointed out to the House Armed Services Committee that "strong alliances of friendly nations, with each carrying its equitable share of the burden of the common defense" was essential to having "sufficiency of military strength." This would be displayed over the following years to various countries and of note in the Middle East where United States contractors found a willing market for military technology with U.S. suppliers pleased to support such countries like Saudi Arabia. Between 1973 and 1980, Saudi Arabia obtained roughly $34 billion in military hardware through FMS and transfers with the Saudi Air Force first modernized with Northrop F–5s and then, by the end of the decade, updating to the more advanced *Eagle*. An observer noted in 1977 that the Saudi military build-up was so rapid that "even if Saudi Arabia were to receive no more military equipment it would take six years for existing personnel to be able to use already bought technology." Some NATO defense chiefs selected the F–16 as their next standard "swing-role fighter" with the aircraft "saddled with NATO's traditional tactical fighter-bomber, ground-attack mission" as well.[115]

Movement of Weapon System Program Offices to Air Force Systems Command

Early in the F–X Program, June of 1969, General James Ferguson, commander of Air Force Systems Command, attended a discussion on F–15 program management that included Deputy Secretary of Defense David Packard, Secretary of the Air Force Robert C. Seamans, Under Secretary John L. McLucas, and Air Force Chief of Staff General John D. Ryan. Out of this meeting, various agreements were reached with AFSC assigned to "manage and perform the research, development, and procurement of systems and equipment to achieve those capabilities." Following the meeting, Ferguson took the opportunity to write General Ryan and bluntly stated that it was time to "take advantage of the current attitude in OSD to streamline Air Force procedures, establish responsibilities clearly, and set the example which will pre-empt any DDR&E attempts to continue their detailed direction of our programs." He further requested the following within the F–15 program – "the transfer of the F–15 Program Element Monitor (PEM) responsibility from Headquarters USAF to AFSC, qualified individuals to function in the F–15 PEM, and a general officer to cover the position as F–15 Program Director" – with General Ryan approving the request with an effective date of July 14, 1969. General Ferguson established the Office of the Assistant for F–15 at AFSC Headquarters, reporting directly to him,[116] and at the same time

US Air Force Chief of Staff, General John D. Ryan.

directed the Aeronautical Systems Division Commander at Wright-Patterson to continue their functional support of the F–15 System Program Office. This decentralization of the F–15 program impressed General Ryan, who in September stated his intentions to "reduce detailed system program management in the Air Force and to depend on AFSC to manage assigned programs in the Washington area." The Chief of Staff, pointed to the F–15 as an example of shifting elements of systems program management to AFSC and directed the transfer of the F–111, Minuteman, and Program 664 to AFSC on November 1, 1969; two months later, the C–5, A–7D, AGM-69, Program 777, Airborne Warning and Control System (AWACS), and others would be added to the list.[117]

Conclusion

The planes of the 1970s were designed to survive in threatening environments, drop tons of ordnance on enemy targets with strike aircraft accompanied by fighter planes, equipped with the newest radar, long-range television, and radiation sensors with the newest antiaircraft missiles to engage enemy aircraft at different ranges. Along with these, electronic-warfare aircraft, such as the E–3 *Sentry* or AWACS, were able to capture enemy communications and integrate the data and command the air battle.[118] It took Secretary Packard, to help with the rise of the fourth-generation airpower with the significant budget cuts that would come in the early 1970s, to change how DoD acquired systems and develop a long-term strategy that ultimately enabled DoD to "modernize its forces during a decade of considerable cost constraints." Packard's most significant contribution during this period was the reintroduction of prototyping and the "fly-before-you-buy" approach to defense acquisition that decreased risk and uncertainty. Elements of Packard's "fly-before-you-buy" approach were implemented at the subsystem level to mitigate risk in the B–1, F–15, F–16, A–10, and AWACS programs along with parts of the original DoD Instruction 5000 series, creating the Program Objective Memorandum (POM) and concepts of the Milestone Decision Authority (MDA), all which contributed to pieces of today's framework of modern acquisition systems with some calling Packard the "father of fourth-generation airpower." However, once leaving DoD, Packard addressed continued frustration with resistance to changes in the acquisition process with individuals objecting to extensive testing with some believing it would "delay" programs but Packard pointed out that testing "showed up things that needed to be fixed and it took time to fix them," thus delaying the "initial operating capability" of the weapon system. He believed that if this thinking was not able to be gotten rid of, there would "be no hope." Ultimately, Packard's reforms led to the launching various platforms—the F–16, F–15, A–10, AWACS, C–17, and the B–1—between 1969 and 1972 that provided the Reagan administration with "production-ready, combat-ready options to modernize the force in the 1980s" with defense aircraft production increasing 80-percent between 1980 and 1986 compared to only 6-percent from 1977 to 1980. Secretary Packard's reforms centered on weapon systems – airframes and propulsion systems – that saw significant use during Operation Desert Storm and still today.[119]

Conversely, predecessors of Air Force Materiel Command also contributed greatly in the years leading up to Desert Storm with systems such as the Low-Altitude Navigation Targeting Infrared for Night (LANTIRN), the Northrop Grumman E–8 Joint Surveillance Target Attack Radar System (JSTARS), and Navigation Satellite Timing and Ranging (NAVSTAR) global positioning system (GPS) to name just a few. In August 1990, LANTIRN was one of the first systems to deploy with the F–15E *Strike Eagle* and F–16 C/D *Viper* of the 4th Tactical Fighter Wing, 247th Tactical Fighter Wing, and the 388th Tactical Fighter Wing. In total, the system flew over 14,000 combat hours with the *Strike Eagles* flying exclusively at night with the LANTIRN system. Two years prior, delivery started with only twelve pods delivered by August 1990 with scheduled completion not projected until 1992 as well as its initial operational capability not reached at the time of deployment. The LANTIRN was directly inserted in combat in some airframes but there was no logistical system in place and no spares nor validated technical orders. Also, the system was still working through initial problems resulting in a support team deploying to the 4 TFW's location "to fill gaps in organic maintenance capability and logistical support."[120] The JSTARS, in January 1991, was still in development with an expected initial operational capability four or five

Boeing E-3 Sentry Airborne Warning and Control Systems (AWACS) and Northrop Grumman E-8 Joint Surveillance Target Attack Radar System (JSTARS) together on the tarmac.

years down the road with software in development and prototype hardware; however, due to a successful field demonstration in Europe during the Fall of 1990 to give Tactical Air Command users an opportunity to preview its capabilities and refine operational requirements, General Schwarzkopf decided to deploy it.[121] Finally, NAVSTAR had been an ongoing program for several years but suddenly found itself in the spotlight with the launching of Desert Storm due to the "featureless environment providing few navigation and location cues" with NAVSTAR providing "precise position, velocity, and time information" to aircrews.[122]

But it was the lessons learned from the Yom Kippur War that showed the cost-effectiveness of fighter-bomber aircraft could be questioned and that it could either prohibit an attacker with a limited quantity from conducting large-scale attacks or necessitate the employment of inexpensive, light-weight aircraft with reduced payloads. New, technologically advanced, air defense threat systems required increasingly sophisticated electronic counter-measure (ECM) equipment, greater use of drones for reconnaissance and electronic support missions, and the employment of stand-off-air-to-surface missiles.[123] It was these lessons from the 1970s that paid off for the U.S. Air Force in the 1990s in the quality and quantity of aircraft and materiel that contributed to the successful air campaign in the Persian Gulf with authors from the Gulf War Air Power Survey noting that the United States provided "all or almost all of the Coalition's command and control systems, electronic warfare aircraft, heavy bombers, cruise missiles, and stealth capabilities…. Some [capabilities] were based on quality [for example, stealth], others on a quantity so great that it brought a quality all of its own."[124]

In the 1992 Department of Defense Annual Budget Report shortly after the Gulf War, Secretary of Defense Dick Cheney stated that "capable and survivable tactical air forces with sustainable global reach would continue to be key to this nation's success in meeting future challenges."[125] It is this future challenge that has current leaders developing new approaches once again to defense acquisition, more notably the growing threat of a militaristic China, an aging workforce, and the growing opportunities of new digital technology.

It is this new digital technology that in 2022 General Duke Z. Richardson, Air Force Materiel Command commander, warned that leaders needed to "get on the bus, or you're going to get run over by the bus" when discussing the use of digital engineering and modeling to design, develop, and sustain new systems. Under Secretary of Defense for Acquisition and Sustainment William A. LaPlante added to this when speaking to industry when he told them that they "…should be moving – if you haven't already – your engineering departments into the digital world." LaPlante explained that the move to paperless designs was not about automating the process but that digital engineering gives the ability to "crunch designs overnight; tens of thousands of designs…digitally, so you can find design spaces you would never have found before" as well as it benefitted new engineers by enhancing and accelerating learning curves with new engineers to create "sophisticated designs, whereas 20 years ago, it might have [required] someone with 10 years of experience" to complete.[126]

Andrew Hunter, Assistant Secretary of the Air Force for Acquisition, Technology, and Logistics, pointed out that the Operational Imperatives laid out by Air Force Secretary Frank Kendall demands "more efficient, and more effective acquisition than what has been possible in the past two decades." He went on at an Air Force Association event in September 2022 to state that this "demands a 'sense of urgency' and focus" because China's goal of becoming the world's top military superpower necessitates "transforming the acquisition system for the 21st century."[127] New acquisition systems have to deal with systems being developed that are software intensive, shying away from the past systems that were the foundations of the acquisition world. But General Richardson sees this as a benefit, not only in the acquisition of the system but also sustaining it, as it "will actually allow us to accelerate all along the life cycle" if the digital 'foundation' was built correctly.[128]

The Air Force has its "job jar" full as it begins to modernize its nuclear deterrence, fielding new weapon systems while finding new ways to sustain legacy systems, much like what was confronted leaders over 50 years ago. Leaders today are challenged with revolutionizing weapon acquisition/sustainment systems to keep pace and answer an economic power and technologically advancing China while encountering resource challenges. ■

NOTES

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2. Perry D. Jamieson, *Lucrative Targets: The US Air Force in the Kuwaiti Theater of Operations*, (Washington: Air Force History and Museums Program, 2001), p. 1; Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey: Summary Report*, (Washington: Government Printing Office, 1993), p. 1.
3. Jamieson, *Lucrative Targets*, pp. 1-2.
4. Keaney & Cohen, *Summary Report*, p. 3; Jamieson, *Lucrative Targets*, p. 3.
5. Jamieson, *Lucrative Targets*, pp. 3-4.
6. *Ibid*, pp. 4-6.
7. Keaney & Cohen, *Summary Report*, p. 1.
8. For the purpose of this paper, total number of aircraft deployed to the Persian Gulf: 120 A–10s, 96 F–15Cs, 46 F–15Es, 168 F–16s, 36 F–117s, and 7 E–3As, Eliot A. Cohen, *Gulf War Air Power Survey, Volume V: A Statistical Compendium and Chronology*, (Washington: Government Printing Office, 1993), pp. 27-28.
9. Keaney & Cohen, *Summary Report*, pp. 3-7.
10. Gen Merrill A. McPeak, Air Force Chief of Staff, to Gen Wilbur L. Creech, letter, 16 January 1991, in Edgar F. Puryear Jr., *American Generalship: Character is Everything: The Art of Command,* (New York: Random House, 2000), p. 226.
11. Bill Creech, *The Five Pillars of TQM: How to Make Total Quality Management Work for You*, (New York: Dutton, 1994), 123 cited in Slife, *Creech Blue*, p. 1.
12. Jamieson, *Lucrative Targets*, p. 41; Keaney & Cohen, *Summary Report*, p. 13.
13. Keaney & Cohen, *Summary Report*, p. 24.
14. Total sorties flown: A–10s, 8084; F–15C, 5685 (Saudi Arabia, 2088); F–15E, 2172; F–16, 13,087 (Bahrain, 166); F–117, 1299; E–3, 379 (Saudi Arabia, 303), Cohen, *Statistical Compendium*, p. 316.
15. These radar systems were an outgrowth of the Forward Looking Advanced Multi-mode Radar Program overseen by Wright Laboratory's Avionics Directorate in the 1970s. R. Ray Ortensie, *FLASHBACK: Wright-Patterson's Support to Operation DESERT STORM*, (Wright-Patterson AFB: HQ AFMC History Office, January 2021), https://media.defense.gov/2021/Jan/22/ 2002569566/-1/-1/1/FB_WPAFB%20AND%20DESERT%20 STORM.PDF; Lt Col (USAF) Joanne S. Schoonover, *Accelerated Air Force Acquisition Processes: Lessons Learned from Desert Storm*, (Maxwell AFB: Air University Press, August 1994), pp. 3-4.
16. Slife, *Creech Blue*, p. 55.
17. Brownlow, Cecil, "Soviet Air Force Unveils Advanced designs for Expanded Limited War Capability," *Aviation Week & Space Technology*, 17 July 1967, pp. 32-39; Richard P. Hallion, *Storm Over Iraq: Air Power and the Gulf War*, (Washington: Smithsonian Institution Press, 1992), pp. 36-7; Maj Brian M. Frederickson, "The Laird-Packard Way: Unpacking Defense Acquisition Policy," *Wright Flyer Paper No. 74*, (Maxwell AFB: Air University Press, 2020), p. 30; Robert W. Drewes, *The Air Force and the Great Engine War*, (Washington: National Defense University Press, 1987), p. 10; Slife, *Creech Blue*, p. 46.
18. CIA, Directorate of Intelligence, "Weekly Review, Special Report: Soviet Air Show Emphasizes New Aircraft, 11 August 1967, DECLASS 10 July 2018; Hallion, *Storm Over Iraq*, p. 37.
19. Drewes, *Great Engine War*, pp. 13-4.
20. Lt Gen John W. Carpenter III, AVCSAF, "The United States Air Force: Where We Stand Today, What's Needed for Tomorrow," *Air Force and Space Digest*, Vol. 52 No. 11 (November 1969), p. 48, (46-50) cited in Yancy Mailes, *Before and After the Storm: The Mythical Nighthawk*, Draft, (Dayton, Ohio, 2023), p. 20.
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22. Laird, *FY 1971 Budget Statement*, pp. 66-7.
23. Foreign Technology Division, "Soviet Threat – General Merrell [support for a briefing for Dayton Area Progress Council on 11 May 1971]," Wright-Patterson AFB, 2 February 1971; General Jack Merrell, Commander of Air Force Logistics Command, Speech given during symposium of the National Aerospace Services Association, Dayton, Ohio, March 1971; General Jack G. Merrell, Commander of Air Force Logistics Command, Speech to Dayton Area Progress Council (DAPC), Dayton, Ohio, May 1971; Perry, *Comparisons*; Hallion, *Storm Over Iraq*, p. 68.
24. Hallion, *Storm Over Iraq*, p. 68.
25. FTD, *Soviet Speech Prep*; Merrell, March 1971 Speech; Merrell, May 1971 Speech; Perry, *Comparisons*.
26. Hallion, *Storm Over Iraq*, pp. 67-68.
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28. Robert S. McNamara, Secretary of Defense, "The Fiscal Years 1969-73 Defense Program and the 1969 Defense Budget," *Senate Armed Services Committee*, 22, January 1968, p. 134.
29. Hallion, *Storm Over Iraq*, pp. 27-28, 31, 37.
30. George and Meredith Friedman, *The Future of War: Power, Technology and American World Dominance in the Twenty-First Century*, (New York: St Martin's Griffin, 1996), p. 250.
31. Hallion, *Storm Over Iraq*, pp. 20-2.
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36. Michel, *Revolt of Majors*, pp. 120-1; Frederickson, *Laird-Packard Way*, pp. 28-9.

37. Capt (USAF) Wayne C. Foote, *History of Concurrency: The Controversy of Military Acquisition Program Schedule Compression*, Masters Thesis, Air Force Institute of Technology, September 1986, pp. 46-48; Allen D. Lee, *A Strategy to Improve the Early Production Phase in Air Force Acquisition Programs*, (Santa Monica: RAND, December 1983), p. 30.

38. Frederickson, *Laird-Packard Way*, p. 3; Michel, *Revolt of Majors*, pp. 121-2; Brown, *Defense Acquisition*, pp. 145-6.

39. Frederickson, *Laird-Packard Way*, pp. 33-4.

40. Fox, *Defense Acquisition Reform*, pp. 42-3, 47-9; Michel, *Revolt of Majors*, pp. 121, 125; Frederickson, *Laird-Packard Way*, pp. 2-3, 29; Brown, *Defense Acquisition*, p. 147; Air Force Systems Command History Office (AFSC/HO), *History of Air Force Systems Command (AFSC), 1 July 1969 – 30 June 1970, Volume I: Narrative*, (Information used is Unclassified), p. 11, hereafter sited as *FY 1970 History*; Foote, *Concurrency*, pp. 53-54.

41. Prototyping was not a new concept in the 1960s as the concept was called Pilot Models prior to World War II. Prototypes are/were utilized to reduce technical risks, validate designs or estimate costs, evaluate manufacturing processes, refine requirements, and/or explore operational concepts. Most prototypes were not the fully designed system and were only designed to various critical performance parameters. Brian Duddy, "What Are Prototypes? Very Useful, But Not Panaceas," *Defense Acquisition*, Vol. XLIX No. 2 (March-April 2020), pp. 26-27, https://www.dau.edu/library/defense-atl/DATLFiles/Mar-April_2020/DEFACQ%20Mar-Apr%202020.pdf.

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43. Michel, *Revolt of Majors*, p. 122; Brown, *Defense Acquisition*, 148; HQ AFSC/HO, *FY 1970 History*, pp. 4-5.

44. Brown, *Defense Acquisition*, pp. 141-2.

45. Frederickson, *Laird-Packard Way*, p. 38.

46. HQ AFSC/HO, *History of Air Force Systems Command, Fiscal Year 1971-1972, Volume I: Narrative*, Andrews AFB, pp. 117-18 [Information used is Unclassified]; HQ AFSC/HO, *History of Air Force Systems Command, Fiscal Year 1974, Volume I: Narrative*, Andrews AFB, pp. 8-9 [Information used is Unclassified]; Neufeld, *F-15 Eagle*, pp. 42-44.

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53. Adam R. Grissom, Caitlin Lee, and Karl P. Mueller, *Innovation in the United States Air Force: Evidence from Six Cases*, RR1207, (Santa Monica: RAND, 2016), p. 53.

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55. Doyle, *Yom Kippur War*, p. 2; AICE, *Yom Kippur War*.

56. Doyle, *Yom Kippur War*, pp. 6-7.

57. Whetten & Johnson, *Yom Kippur War*, p. 103; Bolia, *Overreliance*, pp. 52-53.

58. *Ibid*, pp. 103-4.

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61. Chaim Herzog, *The War of Atonement: The Inside Story of the Yom Kippur War*, London: Greenhill Books, 2003, 261, cited in Doyle, *Yom Kippur War*, p. 9.

62. International Institute of Strategic Studies, "The Middle-East War," *Strategic Survey* 74 (April 1974), p. 55, cited in Doyle, *Yom Kippur War*, p. 10.

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65. Adm T.H. Moorer, Chairman, Joint Chiefs of Staff, to Secretary of Defense, memorandum, 30 October 1973, Enclosure A, cited in Doyle, *Yom Kippur War*, p. 18.

66. Joint Chiefs of Staff, United States Military Equipment Validation Team (US-MEVTI), *Trip Report to Israeli Defense Forces, 28 October – 8 November 1973*, 1973, vii, cited in Doyle, *Yom Kippur War*, pp. 18-19.

67. House Armed Services Committee to Secretary of the Air Force, memorandum, 29 November 1973, p. 2, cited in Doyle, *Yom Kippur War*, p. 19.

68. John L McLucas, Secretary of the US Air Force to General George S. Brown, Chief of Staff US Air Force, memorandum, 30 October 1973, cited in Doyle, *Yom Kippur War*, pp. 19-20.

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71. Grissom, *Innovation*, p. 53.

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73. Robert R. Tomes, *US Defense Strategy from Vietnam to Operation Iraqi Freedom: Military Innovation and the New American Way of War, 1973-2003*, (Abington: Routledge, 2007), p. 58.

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76. Department of Defense, *Report of the Secretary of Defense James R Schlesinger to the Congress on the FY 1975 Defense Budget and FY 1975-1979 Defense Program*, March 4, 1974, Washington: US Government Printing Office, 1974, p. 112.

77. Hallion, *Storm Over Iraq*, pp. 69-70.

78. Michel, *Revolt of Majors*, p. 122; Neufeld, *F-15 Eagle*, pp. 55-64.

79. See Robert Coram's *Boyd: The Fighter Pilot Who Changed*

the Art of War (New York: Back Bay Books, 2002), for a discussion on Boyd's involvement on the designs of the F-15 *Eagle*, particularly chapters "Thirteen: I've Never Designed a Fighter Plane Before", "Fourteen: Bigger-Higher-Faster-Farther," and "Fifteen: Saving the F-15." See also, Aeronautical Systems Division History Office (ASD/HO), *History of the Aeronautical Systems Division (ASD), January 1967 – June 1968, Volume I: Narrative*, Wright-Patterson AFB, pp. 299-308; Neufeld, *F-15 Eagle*, pp. 18-20.

80. Hallion, *Storm Over Iraq*, p. 40; ASD/HO, *History of ASD, Jan 1967 – Jun 1968*, pp. 297-314; Neufeld, *F-15 Eagle*, pp. 55-61; Drews, *Great Engine War, pp.* 30-32.

81. Michel, *Revolt of Majors*, pp. 127-8; Neufeld, *F-15 Eagle*, pp. 32, 55-64; C.R. Anderegg, *Sierra Hotel: Flying Air Force Fighters in the Decade After Vietnam*, (Washington: Air Force History and Museums Program, 2001), p. 154; Maj Robert W. Lyons, *The Search for an Advanced Fighter: A History from the XF-108 to the Advanced Tactical Fighter*, Rpt. No. 86-1575, (Air Command and Staff College, Air University, April 1986), p. 23.

82. Michel, *Revolt of Majors*, p. 123; Foote, *Concurrency*, pp. 56-57.

83. Lee, *Strategy*, p. 131.

84. Schlesinger, *FY 1075 Report*, p. 150; Michel, *Revolt of Majors*, pp. 132-3.

85. Frederickson, *Laird-Packard Way*, p. 60; Michel, *Revolt of Majors*, pp. 126-7; Neufeld, *F-15 Eagle*, p. 48.

86. John T. Correll, "The Costly Alternative to Controlling Cost," *Air & Space Forces Magazine*, 1 June 1983; Lee, *Strategy*, p. 133.

87. Slife, *Creech Blue*, pp. 15-16.

88. Schlesinger, *FY 1975 Report*, p. 150; Michel, *Revolt of Majors*, p. 123; Neufeld, *F-15 Eagle*, pp. 64-66.

89. President Nixon announced on 30 June 1969 the appointment of a select committee of individuals from the private sector, headed by Mr. Gilbert W. Fitzhugh, chairman of the Metropolitan Life Insurance Company. They were to take a year to study the Defense Department, its organization, and operation and became known as the "Blue Ribbon Defense Panel." HQ AFSC/HO, *History of Air Force Systems Command, 1 July 1968 – 30 June 1969, Volume I: Narrative*, Andrews AFB (Information used is Unclassified), p. 28; Michel, *Revolt of Majors*, p. 129. See Department of Defense, *Report to the President and the Secretary of Defense on the Department of Defense by the Blue Ribbon Defense Panel*, 1 July 1970; Foote, *Concurrency*, pp. 54-56.

90. Named after its leader, Allan Simon, who worked in research and development in the Department of Defense.

91. The YF-17 ultimately became the Navy's F-18 and remarked by Packard in his memoir as the "best Navy fighter."

92. Puryear, *Brown*, p. 220; Michel, *Revolt of Majors*, pp. 133-4; ASD/HO, *History of Aeronautical Systems Division. July 1973 – June 1974, Volume I: Narrative*, Wright-Patterson AFB, p. 8.

93. Frederickson, *Laird-Packard Way*, p. 78; Michel, *Revolt*, pp. 137-8; History, ASD/HO, *History of Aeronautical Systems Division, July 1974 – June 1975, Volume I: Narrative*, Wright-Patterson AFB, p. 239.

94. Anderegg, *Sierra Hotel*, p. 176.

95. Frederickson, *Laird-Packard Way*, p. 64.

96. Frederickson, *Laird-Packard Way*, pp. 64-5; Michel, *Revolt of Majors*, p. 128; Anderegg, *Sierra Hotel*, pp. 166-68. For a complete history of the fielding of the A-X/A-10/GAU-8, see R. Ray Ortensie, Ed., *Birth of a Hog: The Beginnings of the A-10 Warthog*, Wright-Patterson AFB, 2021.

97. Anderegg, *Sierra Hotel*, p. 168. For a complete history of the fielding of the A-X/A-10/GAU-8, see Ortensie, *Birth of a Hog*.

98. Hallion, *Storm Over Iraq*, p. 62.

99. *History of Tactical Air Command, Fiscal Year 1974*, 125, cited in Doyle, *Yom Kippur War*, p. 47.

100. Paul G. Kaminski, "Low Observables: The Air Force and Stealth," in *Technology and the Air Force: A Retrospective Assessment*, eds. Jacob Neufeld, George Watson, Jr., and David Chenoweth, (Washington: Air Force History and Museums Program, 1997), 299-300, cited in Doyle, *Yom Kippur War*, p. 47.

101. Ian A. Maddock, "DARPA's Stealth Revolution," in *50 Years of Bridging the Gap*, DARAP, 2012, p. 152, cited in Doyle, *Yom Kippur War*, p. 47.

102. Kaminski, "Low Observables," p. 300, cited in Doyle, *Yom Kippur War*, p. 47.

103. Mailes, *Mythical Nighthawk*, p. 33.

104. Tomes, *Defense Strategy*, p. 79, cited in Doyle, *Yom Kippur War*, pp. 47-8.

105. Also referred to as SENIOR TREND in some sources. Memo, Ed Martin to Ben Rich, "Comments on XST, May 19th ARPA Review," 26 May 1976, https://www.archives.gov/files/declassification/iscap/pdf/2019-010-doc-1.pdf; Timeline, "XST Log, 26 March 1975 to 23 Dec 1977," ca. 1977, https://www.archives.gov/files/declassification/iscap/pdf/2019-010-doc-2-corrected-version.pdf.

106. Aronstein and Piccirillo, Have Blue and the F-117A: Evolution of the "Stealth Fighter", Reston: American Institute of Aeronautics and Astronautics, 1997, pp. 32-33, 154, cited in Doyle, Yom Kippur War, pp. 47-8; Mailes, *Mythical Nighthawk*, p. 50.

107. Brown, *Defense Acquisition*, pp. 148-9. For a look on the Lightweight Fighter Program, see David Aronstein & Albert Piccirillo, *The Lightweight Fighter Program: A Successful Approach to Fighter Technology Transition*, (Arlington: ANSER, 1995).

108. Frederickson, *Laird-Packard Way*, pp. 67-9.

109. Frederickson, *Laird-Packard Way*, pp. 60-1, 68.

110. Frederickson, *Laird-Packard Way*, p. 68.

111. Frederickson, *Laird-Packard Way*, pp. 68-69; Drewes, *Great Engine War*. p. 111.

112. Frederickson, *Laird-Packard Way*, pp. 44-45.

113. Frederickson, *Laird-Packard Way*, pp. 43-44; Neufeld, *F-15 Eagle*, p. 48.

114. Col. (USAF) David R. Olds, "A Case Study: PEACE VECTOR I (Sale of 40 F-16s to Egypt)," *Air Force Journal of Logistics*, Vol. IX. No. 4 (Fall 1985), pp. 21-24.

115. Hallion, *Storm Over Iraq*, p. 41-2; Frederickson, *Laird-Packard Way*, p. 78; Brown, *Defense Acquisition*, pp. 142-144; Michel, *Revolt of Majors*, pp. 126-7, 132-3; Elliot L. Richardson, "Fiscal Year 1974 Annual Defense Department Report," *House Armed Services Committee*, 10 April 1973, p. 20.

116. Brig Gen (designee) Benjamin Bellis was named the new director just three days earlier with the general officer position established from the vacancy opened by the cancellation of the Manned Orbital Laboratory (MOL) program in June. Bellis was the Air Force's most senior R&D manager, with service dating back to the Special Weapons Project at Sandia Base, New Mexico in 1947, and was the first general officer assigned to a Weapon Systems Program Office (WSPO) or Systems Program Office (SPO).

117. HQ AFMC/HO, *FY 1970 History*, pp. 12-14, 17; Neufeld, *F-15 Eagle*, pp. 38-44.

118. Friedman, *Future of War*, p. 250.

119. Production of aircraft and missile engines for defense increased by 14-percent between 1977 and 1980 compared with 69-percent increase from 1980 to 1985. Frederickson, *Laird-Packard Way*, 7, pp. 87-8; Brown, Defense Acquisition, pp. 155-6; Henry, *Defense Buildup*, pp. 3-11; Foote, *Concurrency*, pp. 58-60.

120. Schoonover, *Accelerated*, p. 27; Slife, *Creech Blue*, pp. 62-3.

121. Schoonover, *Accelerated*, pp. 29-30.

122. Schoonover, *Accelerated*, pp. 32-3.

123. Whetten & Johnson, *Military Lessons*, pp. 105.

124. Thomas A. Keaney and Eliot A. Cohen, *Revolution in Warfare? Air Power in the Persian Gulf*, Annapolis: Naval Institute Press, 1995, p. 153, cited in Doyle, *Yom Kippur War*, p. 53.

125. Dick Cheney, Secretary of Defense, *Annual Report to the President and the Congress*, Washington, Government Printing Office, February 1992, p. 84, cited in Doyle, *Yom Kippur War*, pp. 54-5.

126. John A. Tirpak, "Acquisition Reform Takes On a Sense of Urgency," *Air and Space Forces Monthly*, Vol. 105 No. 11 (November 2022), p. 39.

127. Tirpak, *Acquisition Reform*, p. 40.

128. Tirpak, *Acquisition Reform*, pp. 40-1.