Modernizing the Air Force's Electronic Aircraft Fleet

HOW TO SAVE $100 BILLION

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FINDINGS IN BRIEF

The U.S. Air Force operates a fleet of six dozen intelligence, surveillance and reconnaissance (ISR) aircraft based on the old Boeing 707 airframe that are essential to the success of the joint force. Some of the planes are equipped with radars for tracking moving air and ground targets. Others monitor the sensitive electronic signals of adversaries. Still others detect nuclear detonations and arms-control violations.

The manned ISR fleet is aging fast. E-3 AWACS early-warning planes average 35 years of age, E-8 JSTARS surface-tracking radar planes average 45 years of age, and RC-135 Rivet Joint eavesdropping planes average nearly 50 years of age. The Air Force had a plan for replacing the planes, but it was canceled and no new plan has emerged -- due mainly to the high cost of other modernization initiatives already under way.

The cost of sustaining the aging ISR fleet is very high. The four-engine aircraft are not fuel-efficient, and suffer from various age-related problems such as metal fatigue and corrosion. Replacement parts are expensive to obtain, and up to a third of the planes are unavailable on any given day awaiting repairs. Estimates as to how much longer the planes can be safely operated are unreliable, because no one has ever operated jets for as long as some ISR planes have been in service.

The Air Force needs a replacement plan for its ISR fleet that fits within projected budgets. The only affordable solution is to modify commercial transports for military roles, and the leading candidate is the twin-engine Boeing 737 narrow-body airliner. The 737 is the most widely used jetliner in the world -- 10,000 have been ordered -- and has already been modified by the U.S. Navy and foreign governments to carry out the kinds of missions that the ISR fleet currently performs.

The Air Force could save $100 billion over the next three decades by replacing its current ISR fleet with military versions of the 737. Development costs would be relatively low because so much of the engineering has already been done. Production costs would be contained by combining commercial and military assembly in the same facilities, using the same supply chain. Sustainment costs will plummet as aging four-engine planes are replaced with modern twin-engine transports and the Air Force is able to utilize the 737's global maintenance network.

This is the only replacement plan that is affordable within projected budgets. Whatever the virtues of other approaches to modernization may be, they will not be funded in the timeframe necessary to minimize the risk of losing airborne intelligence, surveillance and reconnaissance vital to the joint force. This report was written by Loren Thompson of the Lexington Institute staff as part of the institute's continuing inquiry into the requirements for preserving U.S. military and economic supremacy.

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INTRODUCTION:
MODERNIZING THE AIR FORCE'S ELECTRONIC AIRCRAFT FLEET: HOW TO SAVE $100 BILLION

Intelligence, surveillance and reconnaissance (ISR in military parlance) is a core competency of the U.S. Air Force. The service uses airborne and orbital systems to collect information from across the electromagnetic spectrum -- signals intelligence, imagery, radar returns and the like -- that provides U.S. warfighters with unsurpassed situational awareness. The information not only helps the joint force to fight and win wars, but to deter aggression and detect emerging threats before they become dangerous. No other military service in the world possesses the array of sensing systems and analytic capabilities that the U.S. Air Force does, and those assets are a cornerstone of the U.S. global military posture.

However, a key part of the Air Force ISR fleet is aging fast with no replacements in sight. While the service has made steady progress in deploying next-generation surveillance satellites and unmanned reconnaissance drones, it lacks a plan for modernizing manned sensor aircraft based on the aged Boeing 707 airframe. About six dozen of the aircraft are operational today, including 31 E-3 AWACS radar planes that police air space, 16 E-8 JSTARS radar planes that track moving ground targets, and 17 RC-135 Rivet Joint aircraft that monitor and analyze diverse radio-frequency transmissions. Without these planes, the joint force would often be blind to the approach of enemy aircraft, the movement of hostile ground forces, and the plans of foreign military commanders. So would allies such as Israel and South Korea.

The Air Force had a plan ten years ago to replace its manned ISR fleet with a common airframe, however that plan was derailed by the distractions that followed 9-11. If the planes -- some of which have reached 50 years of age -- are grounded by safety or operational concerns, the service has few backup options for accomplishing their missions. Yet lack of their capabilities in wartime could greatly increase U.S. casualties. Thus a new plan is needed to replace them. Unfortunately, the Air Force is already lagging in efforts to modernize its fighter, bomber and tanker fleets, so there is little hope of finding additional money to also replace its declining ISR fleet in the current budgetary environment.

This study identifies a solution to that problem -- probably the only solution that will work within existing budgets. It proposes early replacement of aging ISR aircraft with successors based on the world's most widely used commercial jetliner, the Boeing 737. The 737 has already been adopted by the Navy as the airframe for its next-generation maritime surveillance plane, and in the process of executing that program the sea service has spent billions of dollars on research and development that can be readily applied to Air Force needs. When the savings generated by replacing ancient four-engine ISR planes with modern twin-engine jetliners are combined with the economies of a worldwide maintenance network, the potential for $100 billion in life-cycle savings is created. The study explains how this solution can be made to work within existing Air Force budgets, requiring no additional funding.

The Air Force draws a distinction between the planes in its ISR fleet dedicated to collecting reconnaissance and those that perform other electronic-sensing functions. However, in this paper the term "reconnaissance" is used interchangeably with all airborne intelligence, surveillance and reconnaissance functions in order to simplify terminology and because many readers are not conversant with the technical differences between various ISR missions.

AIR FORCE INTELLIGENCE, SURVEILLANCE & RECONNAISSANCE PLANES MAKE VITAL CONTRIBUTIONS TO NATIONAL SECURITY

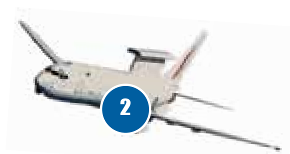
The U.S. Air Force currently operates a fleet of 73 intelligence, surveillance and reconnaissance (ISR) planes based on variants of the old Boeing 707 aircraft. The fleet is unique among the world's militaries in its size and versatility; when combined with the reconnaissance capabilities of Air Force orbital and unmanned airborne assets, it provides vital advantages to U.S. warfighters that no other country can match. Preserving and modernizing the manned reconnaissance fleet is crucial to prosecuting future military campaigns, deterring aggression, detecting threats and enforcing arms-control treaties. However, the fleet is not well understood outside the community of airmen who operate and maintain it.

Probably the best-known aircraft in the fleet are the E-3 "Sentry" Airborne Warning and Control System (AWACS) planes, which carry a rotating radar that can detect and track numerous aircraft over vast expanses of air space. The 31 AWACS planes in the fleet today fly an average of 19,000 hours annually providing essential air surveillance to the joint force and managing aerial engagements by U.S. fighters and other defensive assets when necessary. The easily deployed E-3 is a key reason why no U.S. soldier has been killed by hostile aircraft since the Korean War, and no U.S. pilot has been downed by hostile aircraft since the Vietnam War. A total of 68 AWACS planes were built between 1977 and 1992, half of which were delivered to overseas allies such as the United Kingdom, France and Saudi Arabia. The E-3 has participated in every major U.S. military campaign since its debut.

The E-8 Joint Surveillance and Target Attack Radar System (JSTARS) is similar in principle to AWACS, but uses its radar mainly to track moving ground targets. It can also detect low-flying aircraft such as cruise missiles. The 16 E-8 planes in the Air Force fleet have been successfully employed since the first Gulf War in 1991 to help U.S. ground forces target hostile vehicles such as tanks and terrorist trucks -- even in the dead of night or during raging sandstorms. The E-8 radar is capable of operating in multiple modes to generate various types of targeting information for friendly forces, and often plays a key role in managing air and ground attacks on moving surface targets.

The Air Force also operates 17 RC-135V/W "Rivet Joint" aircraft that monitor and analyze the electronic transmissions of hostile forces. Unlike the E-3 and E-8, which generate radar energy to detect threats, the RC-135 passively eavesdrops on radio-frequency signals in areas of the spectrum where enemy forces are known to operate. Although the deployments and activities of the obscurely-named Rivet Joint aircraft are usually kept secret, such signals intelligence is often of great value to theater commanders, national leaders and overseas allies, revealing the plans and capabilities of enemies. Rivet Joint aircraft have deployed in every U.S. conflict since Vietnam, and are based on a smaller version of the prototype plane that led to the Boeing 707 called the C-135 Stratolifter.

Other, less numerous aircraft in the manned reconnaissance fleet include three RC-135S Cobra Ball aircraft that monitor foreign ballistic-missile launches, two RC-135U Combat Sent aircraft that analyze hostile radar signals, two OC-135B Open Skies aircraft used to determine treaty compliance, and two WC-135 Constant Phoenix aircraft designed for detecting nuclear tests in other countries through atmospheric sampling. Unlike AWACS, JSTARS and Rivet Joint, which each fly over 10,000 hours per year, these more specialized planes are used relatively rarely but still carry out vital missions. Unfortunately, their common ancestry in the Boeing 707 and related airframes developed during the 1950s means they all share a host of age-related problems.



ADVANCED AGE IS MAKING THE CURRENT ISR FLEET COSTLY TO SUSTAIN, AND MAY COMPROMISE SAFETY

As aircraft age, they gradually accumulate weaknesses from exposure to operational stresses such as metal fatigue and corrosion that must be corrected. In addition, replacement parts become harder to obtain once the airframes are out of production, and the cost of the parts tends to rise over time. Despite maintenance and upgrades, much of the onboard equipment grows obsolete and aircraft performance begins to lag behind prevailing industry standards. Eventually, the cost and complexity of sustaining aging aircraft make it unsafe or unaffordable to keep them in service. The Air Force's fleet of intelligence, surveillance and reconnaissance aircraft is fast approaching that point.

Most of the manned aircraft in the current reconnaissance fleet trace their origin to a prototype that the Boeing Company built in 1954. That prototype provided the basic design features for the four-engine 707 commercial jetliner and its somewhat smaller military counterpart, the C-135. The Air Force bought hundreds of the airframes during the Cold War to serve as aerial-refueling tankers, flying command posts, and reconnaissance aircraft. In the case of JSTARS, the service acquired second-hand 707s as the Cold War was winding down and modified them for use as ground moving-target trackers -- a move which saddled the fleet with maintenance problems sooner than they usually arise.

Whether they were acquired new or used, though, all 707/C-135 airframes are now quite old. The 31 E-3 AWACS planes in the U.S. fleet average 35 years of age, the 16 E-8 JSTARS planes average 45 years, and the 22 RC-135 variants average 49 years. A sturdy design has allowed the Air Force to keep the airframes flying even though they were long since retired by most airlines -- fewer than ten remain in commercial service -- but the cost of sustaining one of the world's oldest fleets of jet aircraft is very high. For instance, all of the narrow-body aircraft of similar size being built in the world today have two engines, but Air Force reconnaissance aircraft have four engines that are much less fuel-efficient.

Cost isn't the only penalty that an aging ISR fleet imposes on the Air Force. Because the planes are so maintenance-intensive, they frequently are not available to fly missions. Extended downtimes for maintenance and repair have depressed mission-capable rates, so that on any given day as many as a third of the AWACS, JSTARS and Rivet Joint planes are out of service. That has major operational implications since multiple planes are needed to sustain a single surveillance "orbit" in overseas air space. In wartime, such limitations might deprive the joint force of vital life-saving information. A case in point was the success of E-8 JSTARS planes in tracking enemy armored units during sandstorms in the Iraq War -- a mission requiring multiple aircraft.

Beyond the difficulty of sustaining its aged fleet, the Air Force faces the growing danger of a catastrophic "type failure" in which all 707 or C-135 airframes are grounded due to safety problems. When airframes grow as old as the Air Force's ISR planes have, there is little operational experience on which to base projections of remaining service life. Because the planes currently being used ushered in the age of jet travel, nobody can say for certain how long they will be safe to fly. The Air Force has little capacity to cover urgent reconnaissance needs if the fleet is grounded due to age-related problems.

The E-8 Joint Surveillance and Target Attack Radar System (JSTARS) is equipped with a ground-tracking radar that enabled U.S. forces to find enemy armored units in raging sandstorms during the Iraq War. The Navy's new P-8 Poseidon maritime patrol plane, based on the Boeing 737, carries an advanced version of the same technology that surpasses the performance of the E-8 sensor.

THE AIR FORCE NEEDS A MODERNIZATION PLAN THAT FITS WITHIN PROJECTED BUDGETS

Air Force leaders understand the drawbacks of an aging reconnaissance fleet all too well, since they have to live with its elevated costs and depressed readiness rates every day. The service decided to pursue a next-generation solution ten years ago designated the E-10 Multi-Sensor Command and Control Aircraft, which would have migrated the functions of the E-3, E-8 and RC-135 to militarized variants of the Boeing 767 commercial jet. However, disagreements within the defense department as to how missions should be conducted in the future and the distraction of fighting overseas military campaigns after the 9-11 attacks led to the cancellation of that program. No successor program was ever begun, so at present the Air Force plans to upgrade its ISR planes with new engines and electronics but does not expect to replace the airframes for decades to come.

However, upgrades to the existing planes are controversial because they require spending many billions of dollars on airframes that are well past their prime and may soon be unflyable even with the improvements. For instance, funding has been set aside to begin putting more fuel-efficient engines on the 16 JSTARS radar planes that track moving ground targets, but Air Force planners are reluctant to commit the money because of the decrepit state of the fleet; even if the engines are installed, there are so many other problems with the used 707s comprising the E-8 force that keeping them airworthy looks like a very expensive proposition. The service has declined to install radar upgrades that would allow JSTARS to more precisely track cruise missiles for the same reason, even though a billion dollars was spent developing the necessary hardware and software.

The uncertain outlook for JSTARS typifies the dilemma military leaders face when aging aircraft approach the end of their lives but insufficient funds are available to develop successors. Planners don't want to spend money on upgrades for aircraft that may not be flying much longer, and yet they have little choice but to continue sustaining the planes for lack of successors that can accomplish vital missions. The challenge is especially acute for the Air Force, because plans to modernize its fighter, bomber and tanker fleets have lagged since the Cold War ended, so it must try to keep those efforts on track as military budgets shrink. With so many urgent needs competing for scarce dollars, there is little chance the service will be able to secure additional dollars to recapitalize the reconnaissance fleet.

Ironically, the high cost of maintaining aging ISR planes may offer a way out of this dilemma. The Air Force is currently spending so much money to keep its recon planes operational that it may be feasible to develop and field replacements based on commercial derivatives at little additional cost if it can retire aging 707s and C-135s quickly. If the service avoids its traditional approach to modernization of developing new, military-unique airframes and instead adapts planes that are already used in commercial fleets, then the time and expense required for development can be minimized. Early retirement of maintenance-intensive Cold War planes would free up money to purchase replacements fast, and the lower operating costs of those replacements would keep costs within projected budgets for the reconnaissance fleet. The next section details how savings could be generated from such an approach.

USING COMMERCIAL DERIVATIVES CAN SAVE MONEY ACROSS THE LIFE CYCLE OF MILITARY PLANES

Although the U.S. military usually funds the design and development of new planes when it is seeking next-generation aircraft, the Air Force's reconnaissance fleet is an exception to that rule. By leveraging development work that the Boeing Company had undertaken in the 1950s on its first commercial jetliners, the service was able to economically acquire hundreds of aerial-refueling tankers and other military aircraft over the following three decades. Today, those planes have grown obsolete with age, but the efficiencies of leveraging mature commercial production lines to acquire support aircraft such as radar planes remain. Correctly executed, that approach can save money at each step in the life cycle of next-generation ISR planes.

Money can be saved during initial development because airframes already exist and do not need to be designed from scratch. Engineering and testing focuses mainly on how the airframes should be modified for military missions, greatly reducing the non-recurring costs associated with acquiring new reconnaissance planes. In the case of the 737 these developmental costs would be further defrayed by the fact that Boeing has already developed a successor to AWACS using the 737 airframe for Australia, South Korea and Turkey, and a ground-tracking radar plane using the same airframe for the Navy's P-8 Poseidon program. The latter program has spent $6 billion on various aspects of R&D for the Navy's future maritime patrol aircraft. Thus, much of the engineering required to develop AWACS and JSTARS successors on the 737 airframe has already been funded.

Once in production, the funding profile for next-generation ISR planes would benefit from the economies inherent in utilizing a mature, high-rate production line. Boeing has refined the processes associated with assembling commercial and military aircraft in the same production facility for the Air Force's tanker program and Navy's Poseidon program, so those lessons can be readily applied to a 737-based reconnaissance fleet.

However, the biggest life-cycle savings are realized once the new planes are actually operating in the fleet, because they will be much less expensive to sustain than existing 707 and C-135 airframes. First, the twin engines on the 737 are far more fuel-efficient than the four older engines on 707s, enabling the Air Force to save nearly a hundred million gallons in jet fuel per year. Second, the 737 already has a global maintenance network that can provide support for the plane's airframe and engines, enabling the service to eliminate thousands of maintenance positions. Third, the 737 is so much more reliable than existing ISR planes that the same range of missions can be accomplished with a smaller fleet, enabling the inventory of reconnaissance planes to be reduced from over 70 today to fewer than 60 with no loss of capability.

The cumulative savings of substituting 737s for existing planes would total $100 billion across the life-cycle of the fleet, with annual savings likely to exceed $3 billion once the new planes were fully fielded. Most importantly, the 737 replacement program can be implemented within projected budgets for the ISR fleet, eliminating the need to seek additional money in a difficult budgetary environment.

MUCH OF THE ENGINEERING FOR FUTURE ISR PLANES BASED ON THE 737 HAS ALREADY BEEN DONE

The main reason that the Air Force does not have a plan for recapitalizing its aging ISR planes is the high cost of acquiring new airframes. The "non-recurring" costs of ISR aircraft development are difficult to fit within a modernization budget already stretched by programs to acquire new fighters, bombers and tankers while upgrading legacy planes. However, in the case of the Boeing 737, much of the necessary engineering for next-generation sensor aircraft has already been accomplished in order to meet the needs of the Air Force, Navy, and overseas allies.

The logical successor to the E-3 Sentry AWACS is the Boeing 737 Airborne Early Warning & Control (AEW&C) aircraft developed over the last decade for the Royal Australian Air Force and subsequently ordered by the air forces of South Korea and Turkey. Officially known in Australia as Project Wedgetail, the 737 AEW&C is lighter than the E-3 and hosts a "multirole electronically-scanned array radar" that eliminates the needs for mechanical rotation (a distinctive feature of the Sentry). The radar can simultaneously perform area searches of the air and sea while vectoring fighter-interceptors to targets of interest, and is based on the same technology developed for the canceled E-10 replacement of the AWACS fleet. The airframe is derived from the extended-range variant of the Boeing 737-700, which in its commercial version has an unrefueled reach in excess of 10,000 kilometers. Boeing has delivered six "Wedgetail" AEW&C aircraft to the Australian air force, and has achieved all the performance goals associated with modifying the 737 into a next-generation airborne surveillance platform.

The 737 also provides a suitable successor airframe to the Air Force's various RC-135 derivatives -- Rivet Joint, Cobra Ball, Combat Sent, Constant Phoenix and Open Skies. Boeing has developed a military version of the 700 variant designated the C-40 that is nearly identical to the Boeing Business Jet and is already operated by the Air Force as a flying command post for senior military and government officials. The plane features diverse, secure communications links to assure connectivity between onboard military commanders and the rest of the joint force, and will eventually provide similar features for the Air National Guard. A separate variant of the C-40 is used by the Navy for critical logistical support of its globally-deployed fleet. As with other versions of the 737, the C-40 provides an economical combination of high fuel efficiency, worldwide maintenance availability and extensive parts commonality among variants.

A different variant of the Boeing transport designated the 737-800ERX is probably the optimum successor for the E-8 JSTARS ground moving-target tracker. The 800ERX -- ERX means extended range -- was adopted by the Navy in 2004 as the airframe for its next-generation maritime patrol aircraft. Now known as the P-8A Poseidon, that plane is designed to conduct anti-submarine, anti-surface and intelligence missions over vast expanses of ocean. The Navy has spent $6 billion developing the Poseidon, which integrates a surface-tracking radar that exceeds the performance of the main sensor on the JSTARS aircraft. Because all of the engineering required to install that type of radar on a 737 has already been carried out by the Navy, the 737-800 is the lowest-cost solution to replacing the JSTARS fleet -- enabling the Air Force to avoid much of the bill for nonrecurring development expenses while offering the same operational economies as other 737 variants.

MOVING NOW TO MODERNIZE WITH COMMERCIAL DERIVATIVES WILL SAVE MONEY AND LIVES LATER

The idea of replacing the Air Force's aging ISR fleet with a derivative of the world's most widely-used jetliner isn't really new. It mirrors the approach adopted by the Air Force at the dawn of the jet age when the service chose to carry its airborne sensors on an airframe similar to that of the world's first commercially-successful jetliner, the Boeing 707. However, the technology associated with airborne intelligence, surveillance and reconnaissance has changed markedly since the 1950s, as have the design features of narrow-body commercial transports. The 707 was retired by most airlines a generation ago because compared with newer aircraft it had become obsolete and uneconomical. The Air Force would have done the same with the ISR fleet had its modernization plan not unraveled in the aftermath of 9-11.

The Boeing 737 is now the global standard for efficiency in narrow-body commercial transports. Over 6,000 have been delivered and another 4,000 ordered. The 737 is so widely used that at any given time, 1,250 are airborne around the world, and infrastructure for supporting the plane exists in 190 countries. The 737 is also the only narrow-body commercial transport currently in production that has been successfully modified to carry radars suitable for conducting the missions of E-3 and E-8 aircraft. While no airframe is perfect -- especially when called upon to conduct a diverse array of missions -- there is little doubt that the 737 can meet the future intelligence, surveillance and reconnaissance needs of the Air Force at a lower life-cycle cost than any other airframe.

Unfortunately, one other thing that has changed markedly since the 1950s is the economic capacity of the United States to compete with other military powers. At the time the original prototype for the 707 and its military counterpart was developed, America was the world's biggest creditor nation and accounted for nearly half of global economic output. Today it is the world's biggest debtor and accounts for less than a quarter of global output. With Washington borrowing over a trillion dollars annually and the cumulative national debt rising fast, most experts believe that U.S. military spending will have to fall in the future unless some urgent new threat arises. Thus, the choice in replacing the ISR fleet is not between buying the low-cost 737 within existing budgets and more capable alternatives for additional money; the choice is between buying the 737 and buying nothing.

Although there are numerous options for upgrading the current ISR fleet such as installing new engines on AWACS planes and new radars on JSTARS planes, continuing to pour money into antiquated airframes does not make much sense. The planes are obsolete, and will only become more so as they fly additional years. By developing a plan now to retire 707/C-135 airframes and expeditiously transition to 737 commercial derivatives for all ISR missions, the Air Force can acquire a more reliable and economical fleet of airborne sensors that costs billions of dollars less each year to sustain. In the process it can eliminate 4,000 support billets and save over 80 million gallons of jet fuel each year, freeing up funding for activities where it can be applied more productively. The appeal of this plan resides not just in the $100 billion that would be saved across the lifetime of the recapitalized fleet, but also the many lives of future warfighters and noncombatants that might be saved if a more flexible and resilient ISR fleet is fielded soon.

This airborne early warning and control aircraft was developed for the Royal Australian Air Force using the 737 airframe, and is also being acquired by South Korea and Turkey. Unlike the aging E-3 AWACS planes in the U.S. fleet, which mechanically rotate their radars to achieve 360-degree coverage, the lighter Australian aircraft employs a fixed radar that is electronically scanned.

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The 22 surveillance and reconnaissance planes in the Air Force fleet based on the RC-135 airframe have been in service for an average of nearly 50 years. They must be replaced soon to assure that U.S. leaders and warfighters continue to receive vital intelligence about enemy actions and intentions.

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