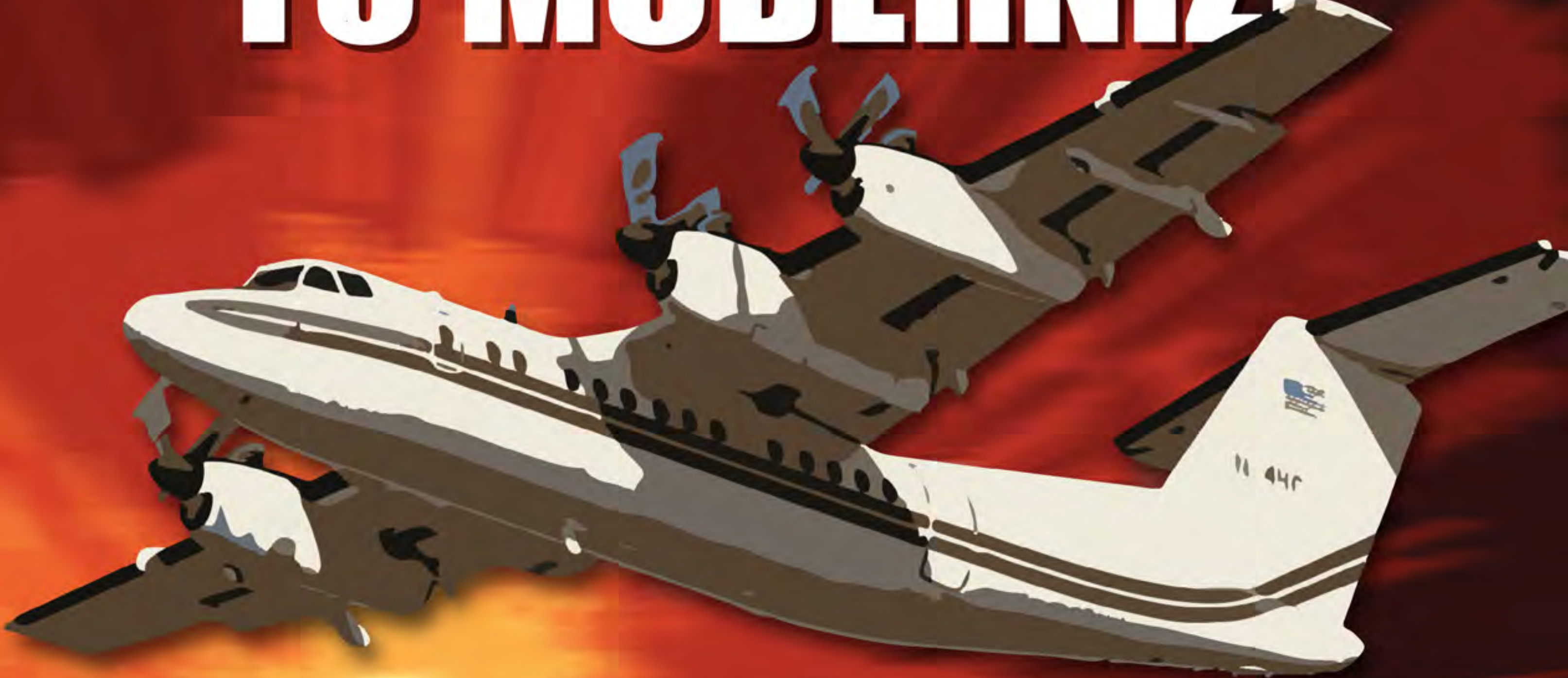
THE RIGHT WAY TO MODERNIZE



THE ARMY'S AIRBORNE RECONNAISSANCE LOW PLANES

Loren B. Thompson

EXECUTIVE SUMMARY

The U.S. Army maintains a small fleet of fixed-wing aircraft for providing timely reconnaissance to its commanders during combat operations. The most capable such planes are EO-5C Airborne Reconnaissance Low (ARL) planes, which detect, identify and track hostile ground targets using a variety of different sensors. This report describes Army plans for modernizing ARL planes, recommending an approach that will assure their tactical relevance through mid-century.

The Airborne Reconnaissance Low component of the tactical-reconnaissance fleet originated in the early 1990s, when the Army modified a handful of propeller-driven regional airliners for use in supporting counter-narcotics and stability operations in Latin America. The planes were subsequently upgraded with additional sensors and communications links to generate specialized reconnaissance along the Korean demilitarized zone, in the Middle East, and in other areas where deployed forces needed prompt, precise information about potential adversaries.

ARL sensing capabilities include high-resolution imaging of remote targets in both the infrared and visible-light segments of the spectrum; interception and localization of radio-frequency communications; and use of synthetic-aperture radar to track both moving and stationary targets. Because it carries a diverse array of sensors, ARL can monitor the movement of elusive enemies day or night, in good weather or bad. By piercing the "fog of war" in a way enemy systems cannot, ARL assures that U.S. soldiers have the situational awareness essential to battlefield survival and success.

ARL bulks large in Army plans for future operations from Africa to the Pacific. However, in order to meet emerging military requirements the fleet will need to be modernized because the current airframe cannot deliver sufficient time-on-station with all the equipment it is expected to carry. A more capable aircraft will be needed, along with a new electronics architecture that can be readily adapted to changing threats. The Army is conducting tradeoffs to determine what design concepts will provide a flexible, affordable solution.

In terms of the airframe, the service will likely stick with a high-wing aircraft that provides maximum visibility for on-board sensors, but it is important to select a plane that will remain in production for some time to come so that the skills and spare parts needed for maintenance can be easily obtained. The plane must also have sufficient payload and range so its capabilities can grow in response to future challenges. The most suitable airframe for meeting future needs is probably the Q400 variant of the Dash-8 manufactured by Bombardier.

In terms of the electronics architecture, the Army needs to transition to an open-architecture, modular design approach so that ARL planes no longer need to carry every sensor that will ever be needed on each mission. A design featuring "plug-and-play" sensor packages that can be readily installed and removed would make it much easier for enhanced ARL planes to achieve the Army's range, endurance and safety goals. By stressing realism in its design assumptions and funding stability in its acquisition strategy, the Army can avoid the kind of mis-steps made in the past that delayed upgrades to its reconnaissance fleet.

This study was prepared by Dr. Loren Thompson of the Lexington Institute staff as part of the institute's continuing inquiry into the technological requirements for future military success.

INTRODUCTION: MODERNIZATION OF AIRBORNE RECONNAISSANCE LOW PLANES IS OVERDUE

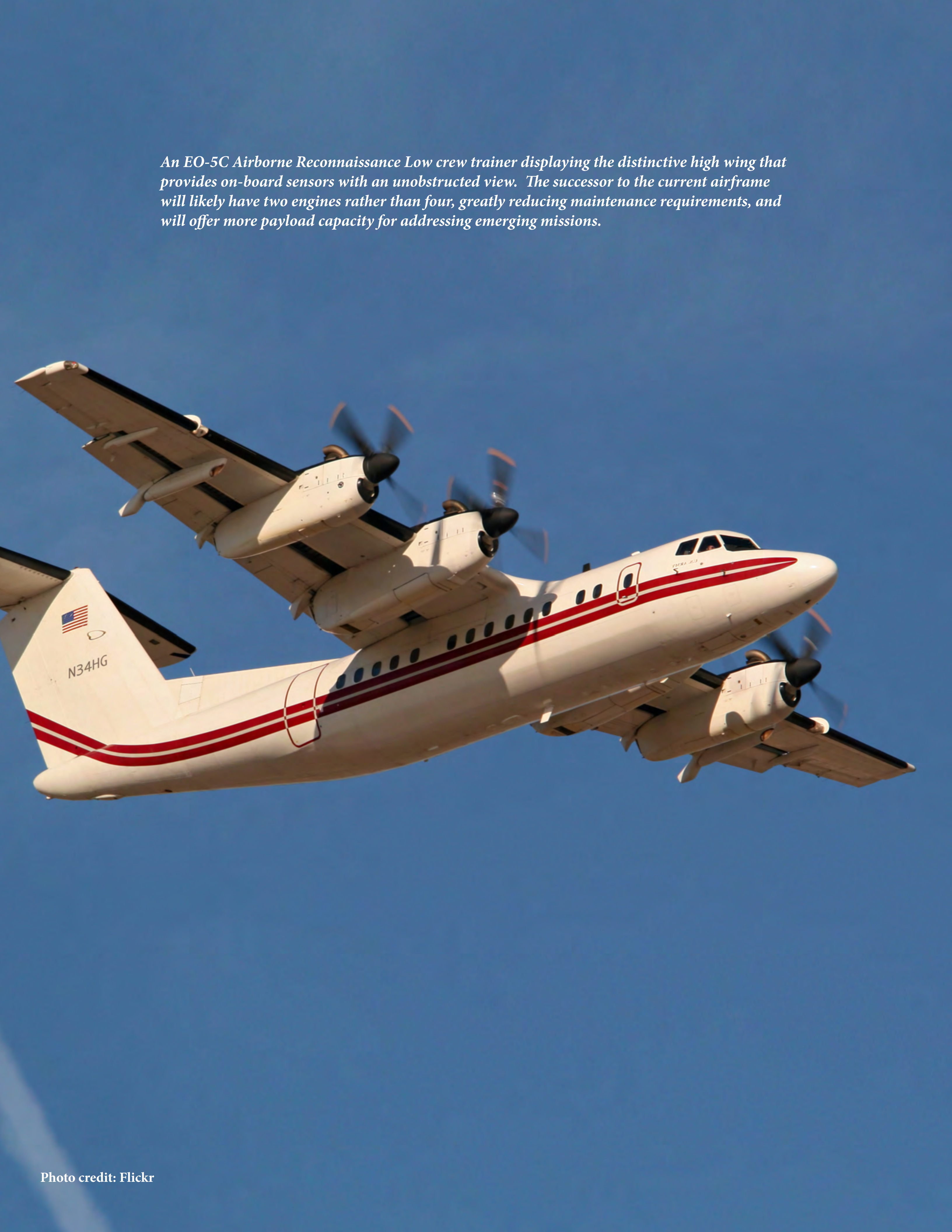
Although Army Aviation consists mainly of rotorcraft, the service also operates a small fleet of fixed-wing airplanes to collect tactical reconnaissance useful to operational commanders. Many of these aircraft were originally developed in response to specific operational requirements, but then evolved to accomplish a wider range of missions. Army leaders believe they must maintain an organic core of fixed-wing reconnaissance assets, both manned and unmanned, to assure that vital tactical intelligence is available to soldiers in a timely fashion.

The nine aircraft designated as EO-5C Airborne Reconnaissance Low (ARL) planes bulk large in Army plans for the future. Originally acquired to support U.S. Southern Command in conducting stability operations, the ARL planes were subsequently modified to perform an array of electronic tasks in the Balkans, Korea, Afghanistan and Iraq. ARL aircraft can intercept and fix the location of hostile radio transmissions, generate high-resolution imagery in the infrared and visible-light portions of the electromagnetic spectrum, and use radars to peer through darkness, dust, clouds and rain in pursuit of elusive adversaries.

However, the airframes hosting all this sophisticated electronic equipment have been out of production for a quarter century, and are operating at the maximum limits of their carrying capacity. The Army needs to develop a new open system "plug and play" architecture suited to addressing the full range of future military challenges, and integrate that architecture with an aircraft that has greater carrying capacity and endurance. Said aircraft should also have sufficient performance margin to allow for future growth in the aircraft's missions, while also being more reliable and maintainable than the airframe currently in use.

This report is about the challenges that the Army faces in modernizing its fleet of Airborne Reconnaissance Low aircraft. It begins by delineating the missions of the Army's tactical-reconnaissance fleet, and the specific tasks that ARL will carry out in support of operational commanders. It then describes the Army's strategy for consolidating fixed-wing reconnaissance assets during the balance of the decade, and explains why the way in which ARL is modernized will determine how useful it is in conducting tomorrow's military operations. The report focuses in particular on the importance of picking an appropriate architecture and airframe for next-generation ARL, and explores how the decisions the Army makes will shape the future of aerial reconnaissance.

The report was prepared by Dr. Loren Thompson of the Lexington Institute staff as part of the Institute's on-going inquiry into the technological requirements for future military success. Although aircraft like Airborne Reconnaissance Low are not well known to the public, they will play an outsized role in how America's Army prosecutes military campaigns in the future, and it therefore is crucial that they be modernized in a manner that assures their effectiveness for decades to come.



An EO-5C Airborne Reconnaissance Low crew trainer displaying the distinctive high wing that provides on-board sensors with an unobstructed view. The successor to the current airframe will likely have two engines rather than four, greatly reducing maintenance requirements, and will offer more payload capacity for addressing emerging missions.

Photo credit: Flickr

AIRBORNE RECONNAISSANCE IS VITAL TO ARMY OPERATIONS

U.S. Army leaders have long understood the tactical advantages of being able to view ground operations from above. During the Civil War the Army placed observers in balloons above battlefields so that Union commanders could better understand Confederate troop movements, and use of aerial spotters became commonplace with the advent of heavier-than-air flight in the early 1900s. Initially, the "sensors" used in these fledgling reconnaissance missions consisted of little more than eyeballs, but with the coming of portable cameras, radios and other innovations, overhead intelligence became an important contributor to the situational awareness of ground forces.

When the Army and Air Force became separate services after World War Two, the expectation was that ground forces would continue to rely on the fixed-wing assets of the Air Force to accomplish tasks beyond the reach or endurance of helicopters. That worked out reasonably well in the case of national-level and theater-level intelligence -- especially after space-based surveillance systems began augmenting airborne collection assets -- but Army commanders found that they often could not rely upon the Air Force to generate tactical reconnaissance in a timely or actionable form, either because Air Force systems were not appropriately configured for certain types of collections or not available in the heat of battle.

This presented serious operational problems for the Army, which it sought to remedy by purchasing a small number of propeller-driven, fixed-wing observation planes such as the OV-1 Mohawk that could provide greater airborne endurance than rotorcraft while being more responsive to the operational needs of tactical commanders. As new technologies became available, the Army gradually added new sensors, communications links and other equipment to its fleet of reconnaissance planes so that they could detect and localize hostile emitters, precisely image threats, and track the movement of ground targets.

The most noteworthy such aircraft still in the active fleet today include RC-12 Guardrail signals-intelligence planes based on the Hawker-Beechcraft B200 turboprop that debuted in 1971, and EO-5C (formerly RC-7) Airborne Reconnaissance Low planes based on the Dehavilland of Canada Dash-7 regional airliner. In recent years, additional manned and unmanned aircraft have been added to the tactical recon fleet as the military launched a series of quick-reaction programs aimed at securing truck routes and targeting insurgents in Southwest Asia. Most of these new reconnaissance assets are surveillance drones, but the Army also developed a twin-engine Medium Altitude Reconnaissance and Surveillance System (MARSS) based on the King Air 350 that is expected to remain in the fleet in an enhanced version.

All of the Army's recon planes have provided operational commanders with information vital to the survival and success of the joint force. They have deployed in every military campaign from Panama to the Balkans to Afghanistan to Iraq, and they also play important peacetime roles in places like the Korean Peninsula. Today, the Army's airborne reconnaissance fleet is heavily oriented to counter-insurgency and stability operations as a result of prolonged engagements in Southwest Asia, but the service has plans to upgrade the fleet for a wider range of future challenges as the military shifts strategic focus to the Pacific. This report is about modernization of the Airborne Reconnaissance Low planes that bulk large in Army plans for the Pacific, Middle East and elsewhere.

Marines carry a comrade wounded by an improvised explosive device in Afghanistan's Helmand province to an Army medical evacuation helicopter. Sometimes the phrase "fog of war" is an all-too-literal description of the confusion encountered in combat, necessitating the use of systems like Airborne Reconnaissance Low to pierce the veil created by rain, dust, smoke and darkness.

Photo credit: BEHROUZ MEHRI/Staff | AFP/Getty Images

AIRBORNE RECONNAISSANCE LOW PROVIDES UNIQUE BATTLEFIELD AWARENESS

Airborne Reconnaissance Low (ARL) planes have been an important component of the Army's tactical recon capability for over 20 years, providing detailed situational awareness to operational commanders with a suite of diverse and sophisticated sensors. Information from these sensors is collected and processed at on-board work stations by technical specialists who then transmit their collections to ground users via secure datalinks. The information is then disseminated to friendly forces through the Distributed Common Ground System, the Army's primary tool for posting, processing and sharing tactical intelligence. ARL thus plays a central role in generating the common operating picture on which soldiers in combat depend to operate effectively.

ARL was developed in response to an urgent operational requirement from U.S. Southern Command for communications intelligence and imagery that could support counter-narcotics and counter-insurgency operations in Latin America. Initially these capabilities were delivered on two specialized versions of the Dehavilland of Canada Dash-7 regional airliner, with one variant intercepting and fixing the location of hostile radio-frequency emitters, while the other concentrated on collecting high-resolution imagery. Shortly after ARL's 1993 debut, though, the Army elected to combine both functions on a single Dash-7 airframe, designated ARL-M ("M" for multifunction). The nine aircraft in the active fleet today are evolved versions of ARL-M.

The Dash-7 aircraft was selected to carry out the Airborne Reconnaissance Low mission because its high wing attached to the top of the fuselage provides on-board sensors with an unobstructed view of ground targets, and its four engines enable the medium-range plane to use airstrips with short runways -- a common situation in the Southern Command area of responsibility. Although the airframe itself was not originally designed for military operations, it has become the most capable tactical-reconnaissance platform of its kind in the world. Its key sensing capabilities include high-resolution imaging of remote targets in both the infrared and visible-light segments of the electromagnetic spectrum; interception and localization of radio-frequency communications; and use of synthetic-aperture radar to track and image both moving and stationary surface objects.

Officially designated the EO-5C aircraft, Airborne Reconnaissance Low has become increasingly important to operational commanders with the advent of counter-insurgency operations in Southwest Asia. The plane's synthetic-aperture radar and ground moving-target tracking capability have been especially useful because they can precisely characterize potential surface threats in darkness, dust, clouds or rain. For instance, the radar carried on the EO-5C can generate pictures capturing details as small as four inches from 16 miles away even in inclement weather, and detect very small changes in surface patterns over time such as the appearance of footprints in sand. That kind of precision is crucially important in combating elusive, irregular forces.

In addition to supporting operations in Afghanistan, ARL plays an ongoing role in monitoring the Korean demilitarized zone and supporting military missions in multiple other locations. The Army has recently issued a solicitation for development work that signals how it intends to further upgrade the aircraft's on-board sensing and processing capabilities. Among the refinements cited are hyper-spectral imaging, foliage-penetrating radar, ground-penetrating radar, and the ability to track dismounted individual fighters. When added to all the other capabilities already resident on Airborne Reconnaissance Low, these features will make the plane a valuable contributor to joint-force operations. However, the Army will first have to find a more capable airframe to host the program's growing array of electronic systems.

THE ARMY HAS A PLAN FOR MODERNIZING ITS RECON PLANES

In April of 2013, the Army delivered to Congress a comprehensive strategy for modernizing its aerial intelligence, surveillance and reconnaissance fleet through 2020. The strategy is designed to reconfigure the fixed-wing recon fleet for a wider range of military missions after a dozen years of focusing mainly on counter-insurgency campaigns in Southwest Asia. It will accomplish this goal by upgrading or replacing a limited number of legacy aircraft while transitioning some of the airframes developed as quick-reaction capabilities for fighting in Iraq and Afghanistan into programs of record. The new strategy will eventually reduce the number of aircraft in the aerial recon fleet from over a hundred to barely 50.

As described in Army documents, the strategy will produce a rationalized fleet of manned and unmanned aircraft consisting mainly of four systems:

- Nine EO-5 Airborne Reconnaissance Low-Enhanced airframes with improved sensors, datalinks and work stations hosted on a new airframe capable of achieving greater endurance with a heavier payload than the current Dash-7.

- Fourteen RC-12 Guardrail Common Sensor (GRCS) signals-intelligence airframes configured in an upgraded "X" variant with digital cockpits and other improvements, representing about half of the RC-12s in the present fleet.

- Twenty-four MC-12S Enhanced Medium Altitude Reconnaissance and Surveillance System (EMARSS) airframes, half of which will be drawn from the quick-reaction inventory developed for overseas contingencies and half of which will be newly acquired.

- Eighteen MQ-1C Gray Eagle multi-sensor unmanned air systems derived from the Predator airframe that will replace legacy Hunter unmanned aircraft in the persistent surveillance and reconnaissance role.

The transition to a new fleet will unfold as the Army gradually draws down its presence in Southwest Asia, retiring many of the tethered aerostats and ground-based reconnaissance systems that were deployed for fighting irregular forces there. As it rationalizes the tactical recon fleet, the service plans to invest in new systems for collecting and interpreting radio-frequency transmissions, providing full-motion video of surface targets, and generating high-resolution still images around the clock in any type of weather. It also will partner with other services in investigating new technologies for tasking, processing, exploiting and disseminating airborne reconnaissance, while continuing to rely on enhanced versions of the Distributed Common Ground System to share multi-source information across the force.

The haphazard fashion in which new reconnaissance assets were acquired during fighting in Iraq and Afghanistan dictated that the service reorganize its capabilities as the joint force shifts strategic focus to the Pacific theater. Previous programs aimed at updating airborne collection and processing capabilities such as the Aerial Common Sensor were not successfully executed, so the fleet has not been thoroughly overhauled since the Cold War ended. During that time, a vast array of new technologies for detecting, tracking and targeting elusive threats has become available, so the new strategy must assimilate those existing and proven sensor technologies into a reconnaissance force that is flexible, responsive and affordable. That will require some creative thinking about how next-generation recon systems are designed and acquired.

THE FUTURE VALUE OF ARL WILL DEPEND ON HOW IT IS MODERNIZED

Airborne Reconnaissance Low - Enhanced Modernization (ARL-E) is the official designation that the Army has given to its planned upgrades of ARL aircraft. When completed, the ARL fleet will consist of nine newer airframes carrying a redesigned suite of sensors and other on-board equipment. The service has not yet performed many of the engineering tradeoffs required to determine how various features of the next-generation ARL system will be balanced to deliver optimum performance at an affordable price, without compromise of safety. However, several overarching concerns articulated in Army doctrine and strategy look likely to drive ARL modernization toward a particular design philosophy.

Perhaps the most important design driver is the transition away from over a decade of intensive counter-insurgency warfare to a more diverse range of military challenges focused mainly in the Western Pacific, Middle East and Africa. ARL will play a central role in addressing this complex array of challenges, because it is the most capable airborne reconnaissance platform that the service operates, and carries sensors suitable for accomplishing many different missions. The Army's Strategic Planning Guidance states that the service must field "regionally-aligned, mission-tailored forces" that are responsive to the requirements of combatant commanders and capable of adapting to new or unexpected needs. Flexibility and upgradeability will be essential in whatever force structure emerges, because the Army cannot afford to field specialized aircraft or combat units for every conceivable eventuality.

More broadly, Army leaders believe that the nature of warfare has shifted dramatically with the coming of the information age as non-traditional adversaries are empowered by new technology and become as great a threat to national security as more traditional, state-based enemies. The old pattern of episodic crises involving linear maneuver formations and well-defined rear areas has given way to an era of persistent worldwide conflict in which combat is non-linear, danger can approach from any direction, and strategy is executed by small units in decentralized fashion. This brave new world of chaotic conflict puts greater emphasis on shared situational awareness and cooperation among scattered units that rely on a common network and timely, precise intelligence.

The changing nature of land warfare clearly has implications for how tactical reconnaissance assets are designed and used. On the one hand, operational commanders need access to many different forms of reconnaissance collected from across the electromagnetic spectrum -- intercepted radio-frequency transmissions, visible and infrared imagery, full-motion video, ground moving target indications, etc. On the other hand, they need sensor platforms capable of staying on station above areas of interest for far longer than the six or seven hours that ARL planes are capable of delivering with their present payloads. This appears to require more than just buying a bigger plane -- it implies a wholesale revision of the way in which sensor payloads are installed and configured.

With so many novel threats challenging U.S. interests overseas and so many new technologies to detect and track them, it is becoming impractical to carry every sensor that ARL planes might one day need all of the time. That approach results in planes carrying a great deal of excess electronic "baggage" on every mission, reducing aircraft endurance and wasting fuel. A more sensible design philosophy would be to field modular, reconfigurable sensor packages that can be installed or removed quickly as missions dictate to limit the amount of weight that must be carried. Using open-architecture design principles, the resulting "plug and play" architecture would facilitate support of diverse users and continuous evolution of on-board capabilities within an affordable framework. (Proper positioning of sensors to conform with air-worthiness directives will be an additional design consideration.)

Soldiers conduct a night patrol along the demilitarized zone that separates North and South Korea. Airborne Reconnaissance Low planes are used to monitor the zone for signs of hostile behavior by North Korea's military, providing U.S. and South Korean forces with the situational awareness they require to successfully repulse an attack.

Photo credit: Lee Hae-yong | Associated Press

ENHANCED ARL NEEDS A TRULY FLEXIBLE SENSOR ARCHITECTURE

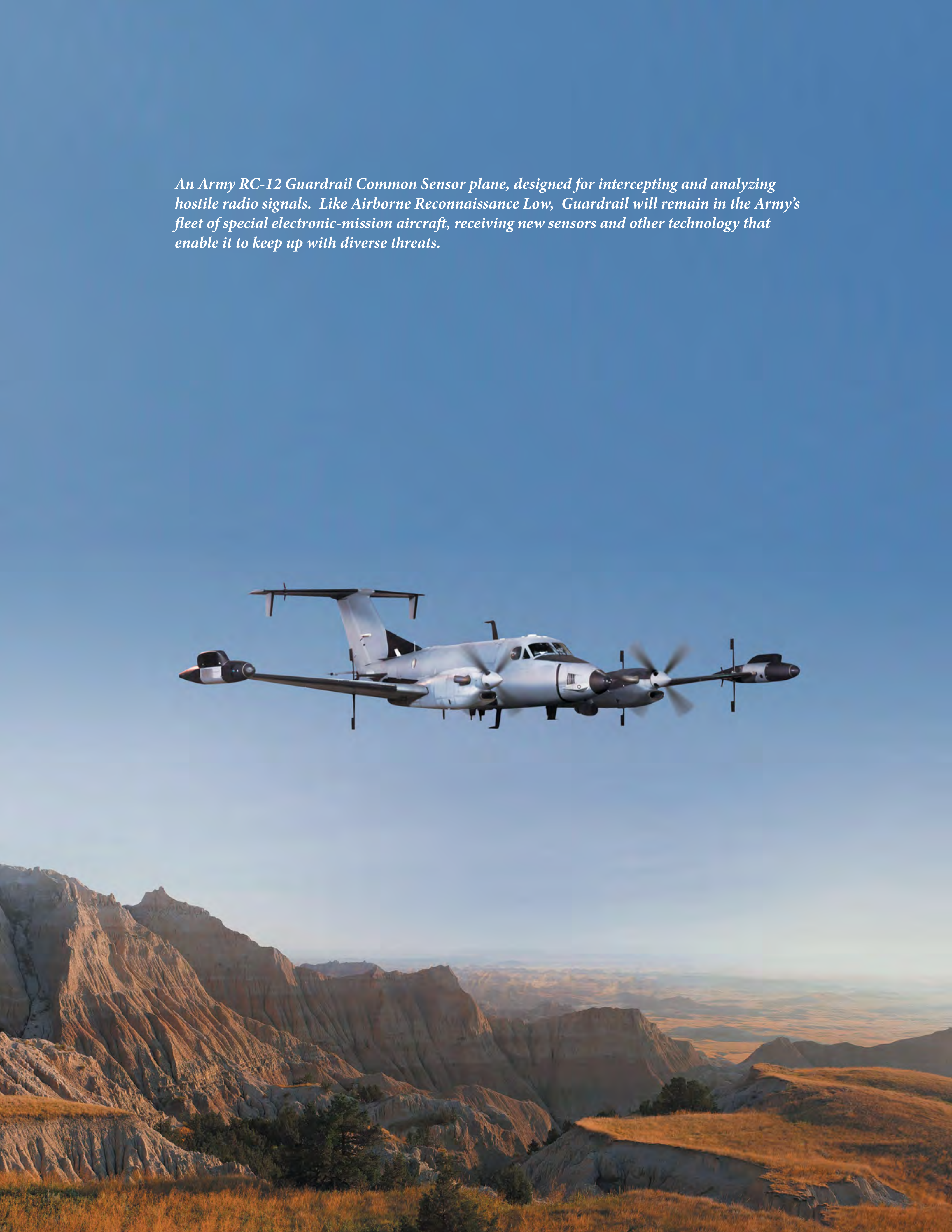
Airborne Reconnaissance Low planes execute diverse missions for multiple regional commanders using a variety of sensors. In Afghanistan, their missions have focused mainly on counter-insurgency warfare. In Korea, their role has been to monitor likely vectors of North Korean attack for any sign of danger. In Latin America, they have been heavily engaged in counter-narcotics operations. Each region poses its own unique military challenges, requiring a different combination of sensors and operating procedures. The array of needs that ARL must meet is likely to grow in the future as novel threats emerge and the joint force focuses more on areas like Southeast Asia and Africa.

When ARL was first conceived in the early 1990s, Army planners did not -- indeed, could not -- anticipate the many ways in which it would one day be used. Now that the Army has grasped the fluid, complex character of contemporary threats, though, it should be obvious that a new approach to designing and utilizing ARL's successor is required. The failure of the joint Aerial Common Sensor program to generate a viable replacement for ARL strongly suggests that it is not feasible to equip each airframe with all the sensors that might one day be needed to accomplish missions assigned to the tactical recon fleet. The canceled program was a classic example of trying to permanently stuff too much equipment into too little space, (known as the "A" Kit), and its lessons should not be ignored.

If the Army wants to increase ARL's time on station for the full array of potential missions while still being able to operate out of relatively small airstrips -- its stated intention -- then it will have to consider developing a sensor architecture that does not carry every conceivable sensor on every mission. In other words, it will need to acquire multiple packages of sensors that are optimized for particular types of missions, and switch them among airframes depending on what roles each plane has been assigned. This implies a modular, "plug-and-play" approach to sensor design that permits systems to be rapidly installed on or removed from planes by line technicians not possessing special skills.

Acquiring a rapidly reconfigurable sensor architecture would greatly enhance the productivity of each ARL airframe by increasing range and endurance while decreasing maintenance requirements and fuel consumption. It would enable the Army to achieve its goal of fielding a tactical recon fleet that is regionally focused, mission-tailored, and highly responsive to the requirements of combatant commanders. In addition, reconfigurable sensor payloads would permit the Army to continuously evolve capabilities in response to new challenges while minimizing the costs of ownership for the fleet and avoiding being locked into the use of particular systems or suppliers. In a word, reconfigurability delivers flexibility for the future.

These ideas are not new. They have been gaining credence since that dawn of the information age as military planners grasped the need to continuously adapt to new circumstances. It is not entirely clear that the Army's current approach to system acquisition can accommodate a design concept for future ARL-E that affords maximum flexibility, and operators will doubtless have to rethink how they task and exploit the capabilities resident on each plane. However, the Army's Strategic Planning Guidance and various doctrinal pronouncements clearly forecast the coming of an operational environment in which carrying around every sensor that might one day be needed is not affordable or feasible, so sensor reconfigurability necessarily should be a central feature of an enhanced Airborne Reconnaissance Low program.



An Army RC-12 Guardrail Common Sensor plane, designed for intercepting and analyzing hostile radio signals. Like Airborne Reconnaissance Low, Guardrail will remain in the Army's fleet of special electronic-mission aircraft, receiving new sensors and other technology that enable it to keep up with diverse threats.

PICKING THE RIGHT AIRFRAME FOR FUTURE ARL IS CRUCIAL

Whatever design concepts are used to develop the sensor payload that will accomplish Airborne Reconnaissance Low missions in the future, it is obvious that a new airframe is needed to host that payload. The Dehavilland of Canada Dash-7 planes currently being used were purchased second-hand from regional airlines in the 1990s because their high-mounted wings afforded unobstructed sensor views of surface targets and their four engines enabled the planes to use austere airstrips with short runways. In addition, they were relatively inexpensive to acquire, at least in part because commercial operators wanted to unload an aircraft with high fuel and maintenance costs. Twenty years later, the Dash-7's look woefully out of date and need to be replaced as soon as possible.

Army planners understand the limitations of the Dash-7 and are assessing what airframes might provide a suitable successor. The search for a new ARL aircraft seems to be focused mainly on variants of the Dash-8, evolved versions of the Dash-7 with the same high-mounted wing but only two engines that are considerably more powerful than the four engines on the current ARL planes. Because they have so many moving parts, turboprop engines require continuous maintenance and thus contribute significantly to the ownership costs of any airframe on which they are used. Switching from a four-engine airframe to a two-engine airframe thus offers inherent economies and the potential for significant gains in reliability.

If the Army confines its search for a new airframe to the high-wing Dash-8 series of aircraft, then it essentially has two options. The first option would be to buy used aircraft that are no longer in production, as it did in the case of the Dash-7. The second option would be to buy used aircraft in the latest Q400 variant of the Dash-8, which is likely to remain in production for years to come. The Q400 shares many of the same features as earlier variants of the Dash-8 no longer in production, but is significantly larger. Superficially, that would appear to make the latest Dash-8 more expensive to operate, but the experience of operating the Dash-7 suggests that over the long run it is more economical to operate a plane that is still being built.

The reason why this is so is that once aircraft go out of production, spare parts become harder to procure and their prices gradually rise. In the case of the Dash-7, of which fewer than four dozen are now operating worldwide, the Army often has to buy customized parts because the original supply chain has disappeared. In addition, mechanics qualified to work on the Dash-7 have aged with the airframe, making it harder and harder to obtain the expertise required for aircraft sustainment. Bombardier, the successor to Dehavilland in the production of Dash-8 aircraft, decided to end production of all variants except the Q400 in 2009. Thus, it is just a matter of time before those earlier variants begin to experience the sustainment challenges seen on the Dash-7 today.

Purchasing the Q400 to serve as the future airframe for Airborne Reconnaissance Low, whether new or used, would probably be the most economical option over the long run. A business-case analysis conducted at the Naval Post-Graduate School in late 2011 found that the Q400 would offer approximately a third more performance than the Dash-7 for a third less cost. The Q400 also outperforms earlier versions of the Dash-8 in performance measures such as carrying capacity, endurance and space for future growth. With so many aspects of the future operating environment unclear, purchase of the larger Q400 appears to be a safer, more cost-effective option than once again acquiring used planes that are no longer being built.

CONCLUSION: THE ARMY NEEDS TO DO ARL MODERNIZATION THE RIGHT WAY

Airborne Reconnaissance Low has evolved from modest beginnings to become one of the Army's core intelligence assets. It supplies vital and diverse information to U.S. operational commanders around the world that they could not easily obtain in other ways. And it is more responsive to their needs than the assets of other services are ever likely to be. So it is not hard to understand why modernizing ARL is a pillar of the service's plans for rationalizing tactical-reconnaissance capabilities as the joint force shifts strategic focus to the Pacific. However, plans for improving tactical recon have faltered repeatedly since the Cold War ended, so it is important not to repeat the mistakes of the past in preparing ARL for future challenges. Five principles should guide ARL modernization:

- **MISSION-DRIVEN FOCUS.** The value of ARL hinges on its responsiveness to the needs of operational users, so it must be configured first and foremost with an eye to the missions it is expected to execute. Program managers must not allow the tradeoff of technical features to obscure the fact that in the end, ARL exists to meet the reconnaissance needs of commanders in specific places facing particular challenges.

- **FLEXIBLE ARCHITECTURE.** The proliferation of novel threats and new technologies has made it impractical for reconnaissance planes to carry every piece of equipment that might conceivably be needed one day. If the Army wants to avoid operating recon planes that cost $40-50,000 dollars per flight hour as some Air Force assets do, then it must transition to a modular, reconfigurable sensor architecture designed for a "plug and play" environment.

- **GROWTH POTENTIAL.** There was no way Army planners could have predicted how many masters ARL would one day serve when the program was first conceived. The reconnaissance requirements of operational commanders only become clear once they are deployed, and then evolve continuously. So the electronic architectures and airframes selected to execute recon missions must provide adequate margins for future growth as needs dictate.

- **DESIGN REALISM.** The last time the Army tried to develop a successor for ARL, the program collapsed because engineers tried to cram too much capability into too little plane. This time around, they must avoid over-defining requirements and trying to stuff ten pounds of sensors into a five-pound bag (or ten pounds of engineering into a five-pound schedule). A successful ARL modernization effort must begin with realistic mission assumptions and requirements.

- **COST STABILITY.** Army modernization programs in recent years have been plagued by frequent restructures that drove up costs and delayed the fielding of new capabilities. The most common cause of such restructures was shortfalls in funding as the service sought to wage multiple overseas military campaigns while also transforming its approach to warfare. Getting ARL right depends on avoiding such restructures, which almost always weaken programs.

If modernization of Airborne Reconnaissance Low is carried out the right way, it will remain a vital asset for the Army through mid-century. In fact, it will be more cost-effective and capable than any other tactical-reconnaissance system in the world. If it is carried out incorrectly, without assimilating the lessons of the past, then the Army may once again find itself marching off to war without the reconnaissance assets needed to defeat new threats.

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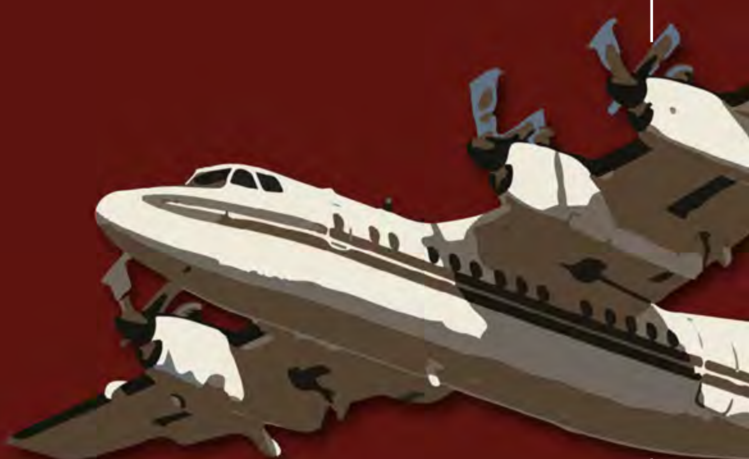

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