The manned-**un**manned DEBATE

An X-47B unmanned demonstrator is prepared to take off alongside a manned F/A-18 fighter aboard the carrier Theodore Roosevelt. The Navy is trying to determine requirements for a future unmanned, carrier-launched, airborne surveillance and strike aircraft.

U.S. Navy

Planning a future mix of manned and unmanned combat aircraft poses the daunting task of comparing the cost effectiveness of competing airframes. Robert Haffa and Anand Datla offer an analytical framework for building the most appropriate mix.

ANALYSIS
by Robert Haffa and Anand Datla

The recent battle over whether to keep flying the Air Force's fleet of 32 U-2 spy planes or replace them with unmanned Global Hawk aircraft looks like a harbinger of future manned-unmanned debates. After examining the advantages and disadvantages of each aircraft, the Obama administration included funding for both in the fiscal 2016 Defense Department budget request. This compromise reflects the challenges the Pentagon encounters whenever it tries to integrate unmanned aircraft into a force. As the military services and Congress contemplate a future mix of multimission, manned and unmanned combat aircraft, they will try to weigh the cost effectiveness of competing airframes.

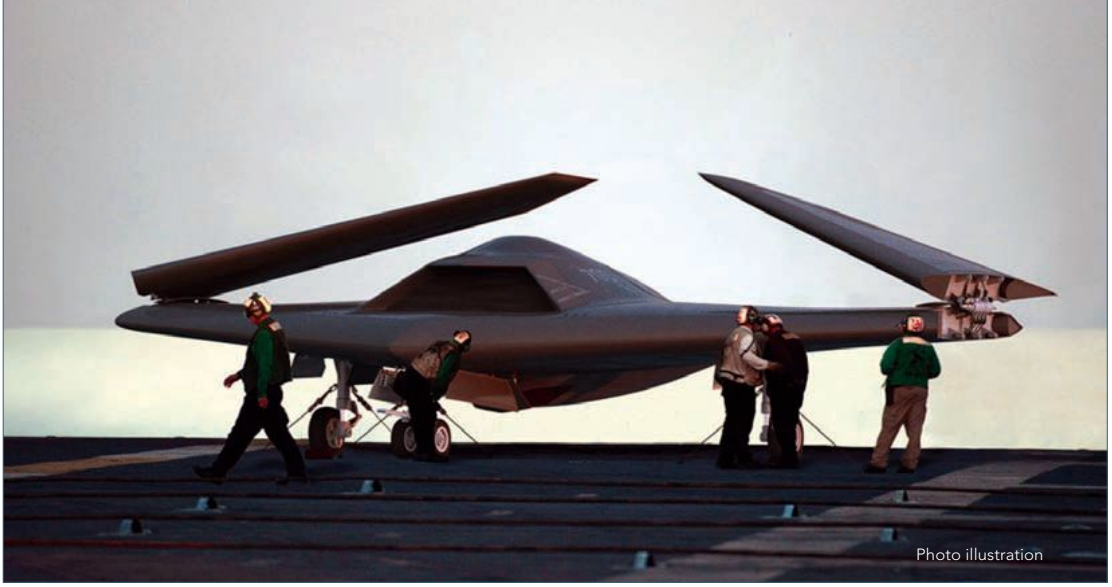
Doing so is inevitably complicated, but it is doable. The competing planes may be of different generations, which means they will have different capabilities, fuel efficiency figures, spare parts costs and reliability predictions. Comparisons of traditionally piloted and unmanned combat aircraft, however, can be simplified by first calculating the cost of the capability — surveillance, strike, electronic warfare or some combination thereof — provided by an unmanned platform and then determining the cost of that same capability for a manned combat aircraft. In conducting this analysis of alternatives for new aircraft acquisitions, all platform characteristics are assumed to be identical — the only differences are the number of aircraft, people and flying hours required to generate the specified capability.

Unmanned aircraft show a significant life-cycle cost advantage over manned aircraft when both airframes are assumed to have identical range, payload, sensors and survivability in contested airspace. This is primarily because advanced unmanned aircraft will have highly autonomous flight and navigation systems that obviate control from the ground by trained pilots. Instead, they receive a set of mission objectives to be executed by on-board computers directing the aircraft to specific places at designated times and activating appropriate sensors. A human controller is needed only to redirect the aircraft if required and to release precision-guided weapons. This approach frees the human operators of remotely piloted vehicles to manage and analyze mission objectives and alter them according to changing mission requirements. Because all of the aviation skills reside in the vehicle's software, there will be no need to teach a human to fly the aircraft. Today, training pilots and maintaining their proficiency account for a large portion of the total life-cycle cost of combat aircraft. Eliminating this training in our analysis results in significant immediate and long-term savings because fewer flying hours are required and fewer aircraft must be procured.

But that's just the entering argument. The ultimate mix of manned and unmanned combat aircraft also depends on the mission assigned and the degree of man-in-the-loop decision making required to accomplish that mission. The long-endurance capability of unmanned aircraft, eventually to be enhanced by aerial refueling, gives them a decided edge in missions requiring persistence in a target area. On the other hand, manned aircraft have the advantage in situations such as dynamic strike missions or air-to-air combat, because in situ human pilots are still better in those scenarios than computer-programmed flight paths. However, unmanned aircraft can assume most tasks requiring significant combat persistence, surveillance and strike currently performed by manned aircraft — an advantage evident in Predator and Reaper counterinsurgency and counterterror operations.

Carrier aircraft

The Navy is struggling with the requirements for its unmanned, carrier-launched airborne surveillance and strike, or UCLASS, aircraft. Those decisions can be aided by this framework for analysis, as well as by the Navy's earlier decision to replace the manned P-3 Orion maritime surveil-



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Line-of-sight communications, instead of satellite links, could make it affordable to fly unmanned surveillance and strike planes from carriers.

lance and patrol aircraft with a mix of traditionally piloted Boeing 737-based P-8 Poseidons and unmanned long-endurance Tritons, a Global Hawk variant.

Choosing unmanned aircraft for the persistence mission will result in considerable cost savings, but opting for an all-unmanned fleet would require non-line-of-sight satellite communication links to allow remote operators halfway around the world to control long-range operations. Non-line-of-sight links tend to be expensive and susceptible to jamming, so an alternative would be to establish line-of-sight links between unmanned planes and traditionally piloted aircraft whose crews would communicate with them and adjust their flight paths as required. The Navy could assign the persistent surveillance/strike mission to UCLASS, with the attack of time-sensitive targets in contested airspace controlled by standoff manned aircraft. The fixed-target attack mission could be delegated to manned attack aircraft supported by an advanced unmanned formation.

Such a communications-connected force mix would address all target classes, permit robust command and control of unmanned platforms without the need for vulnerable and expensive beyond-line-of-sight communication links, and optimize the cost and effectiveness of the carrier air fleet.

The F-35 might be the last fighter that requires a human pilot for all versions of the aircraft. Next generation fighters are likely to be produced in manned and unmanned variants.

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Long-range strike bomber

A similar approach might be applied to analyzing the Air Force's acquisition of long-range strike bombers. The new bomber might have an unmanned variant, and that could lower the life-cycle costs considerably. Another option would be to buy an unmanned combat aircraft similar to UCLASS. In either case, the aircrews in the manned bombers could provide the human-in-the-loop functions required to control the unmanned bombers in a dynamic, persistent surveillance/strike role. The manned and unmanned variants would be able to communicate through line-of-sight links to minimize the need for expensive, secure satellite communications. The crew members could monitor and confirm the unmanned aircraft's route, threats and target coordinates; appraise potential targets detected by the long-dwell unmanned bombers; authorize attacks; and assess battle damage.

Some have warned against making the new bomber capable of delivering nuclear weapons lest it become entangled in future strategic arms control treaties. However, it is likely that the new bomber will have a nuclear weapons capability. The prospect

of an unmanned aircraft launching a nuclear weapon should not be difficult to accept for those who have fielded an intercontinental ballistic missile and cruise missile force over the decades. But having a mixed manned/unmanned bomber fleet would mitigate the problem by assigning nuclear weapons delivery missions to the manned version.

Next-generation fighter

What of the next conventional fighter — the so-called sixth generation likely to be granted seed money in the fiscal 2016 budget? Although former Chairman of the Joint Chiefs Adm. Mike Mullen speculated that the F-35 would be the last manned fighter the U.S. would field, it is probable that a next-generation fighter will have manned and unmanned versions. That's because manned aircraft deal better with situations requiring human judgment and unforeseen events while mitigating the potential vulnerability of most existing unmanned aircraft to communication failures.

Nevertheless, there are two important fighter missions that could be supplemented by unmanned aircraft at considerable savings and increased effectiveness. The first is cruise missile defense of forward military bases and facilities. Armed with advanced air-to-air missiles similar to those carried by the manned variant, an unmanned sixth-generation fighter could contribute to both ground and airborne alert missions for cruise missile defense, reducing procurement and operating costs significantly. In this case, crew members aboard an airborne warning and control system aircraft, or AWACS, equipped with secure communications suites would direct the unmanned fighters to the desired launch point and issue fire instructions.

Another possible mission for an unmanned fighter would be defensive counterair patrol. In many cases, defensive counterair will be conducted in an environment cluttered with enemy and friendly aircraft. That dynamic dogfight will still require voice communications and human judgment to distinguish friendly fighters from the adversary and to adjust flight tactics accordingly. Therefore, unlike cruise missile defense, where an unmanned aircraft might be able to assume the mission completely, in defensive counterair the unmanned variant will likely supplement manned fighters. Nevertheless, the unmanned fighters could be controlled via line-of-sight communication links either by crew members on an AWACS or the pilots of the manned fighters. In the latter case, the fighter pilots could employ sensors and weapons on board their unmanned wingmen as well as those on their own aircraft in a complementary, cost-effective concept of operations.

So, how does all this balance out in our notional analysis? The framework offered here suggests that fleets composed solely of unmanned aircraft, owing to reduced training, acquisition and life-cycle costs, are less expensive to acquire and operate. In missions such as gathering intelligence, surveillance and reconnaissance, where a premium is placed on persistence rather than flexibility, unmanned systems can do the job as well as, if not better than, manned aircraft, at significantly lower cost. The Global Hawk, for example, provides longer range and endurance while carrying more sensors (but not the same sensors with equal fidelity; hence the manned-unmanned mix we referred to earlier) than the U-2, for less than half the cost per flying hour.

For other missions, a mix of manned and unmanned combat aircraft would prove more cost-effective and capable than a single force of either type. For the Air Force and the Navy, acquiring a mix of fighter-size unmanned combat aircraft and manned, or optionally manned, bombers offers cost and effectiveness advantages. Those services should consider procuring advanced unmanned combat aircraft at a more aggressive pace.

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Robert Haffa is a senior fellow at the Center for Strategic and Budgetary Assessments in Washington, D.C. He recently retired from Northrop Grumman, where he directed the Analysis Center, the company's think tank charged with understanding the future path of American defense and security policies.

Anand Datla is a consultant based in the Washington, D.C., area. He is a former Defense Department strategic planning analyst and served as a professional staff member of the House Armed Services Committee.