Performance Audit of Department of Defense Intelligence, Surveillance, and Reconnaissance

House Permanent Select Committee on Intelligence

April 2012

Executive Summary

The Department of Defense's success with Intelligence, Surveillance and Reconnaissance (ISR) in Iraq and Afghanistan has fueled an exponential growth in new and enhanced ISR capabilities over the past decade. DoD has spent about $67 billion on ISR since 9/11[1] but has failed to strategically plan for how this investment relates to future requirements. Oversight has not kept pace with the burgeoning investment in ISR, contributing to many inefficiencies in DoD's ISR portfolio. It is now imperative to rationalize DoD's ISR force structure as fiscal pressures necessitate a contraction in defense spending, and the Afghanistan war starts to wind down.

Acquisition: DoD has invested roughly $44 billion in acquiring new and enhanced ISR capabilities since 9/11[2] without a strategy for how these systems fit into its future ISR architecture. DoD has allowed the Services to procure their own solutions for joint requirements, leading to duplication and inefficiencies. DoD now needs to improve its acquisition process to prevent further duplication of effort and right-size the ISR force for future requirements. Meanwhile, most of the assets currently deployed to Afghanistan will return to the United States, and DoD will have to decide which to keep and how to re-allocate them to Combatant Commands in a way that maximizes their value within constrained resources. However, DoD currently lacks the process and analytical tools to do this.

Training: Operator training for DoD's current inventory of Unmanned Aircraft Systems (UAS) is unsustainable due to cost and airspace constraints. It is also inefficient due to stove pipes among Services and platforms. These challenges are partly a product of lagging technology and partly of poor coordination among Services. However, there are opportunities on the horizon to consolidate training for new systems with existing training programs and to develop technology that heads off an impending training crisis. The future of ISR is increasingly unmanned. If DoD is to maintain a cadre of well-trained UAS operators, it needs to stay ahead of the inevitable training cuts and airspace shortages by making the right investments now.

Recommendation Highlights

- DoD should start using cost-benefit analysis in its ISR acquisition decisions and the re-allocation of existing ISR assets from Afghanistan to COCOMs.
- DoD should identify quick reaction ISR capabilities that can be mothballed or sold.
- The ISR Task Force should be disbanded at the end of its Afghanistan mission.
- DoD should expedite the development of its strategic plan for UAS training.
- The Services should improve the realism and interoperability of their UAS training simulators so that they can substitute more simulated training for live training.

[1] HPSCI staff estimate based on a USDI data call to the Services in January 2012.
[2] HPSCI staff estimate based on a USDI data call to the Services in January 2012.

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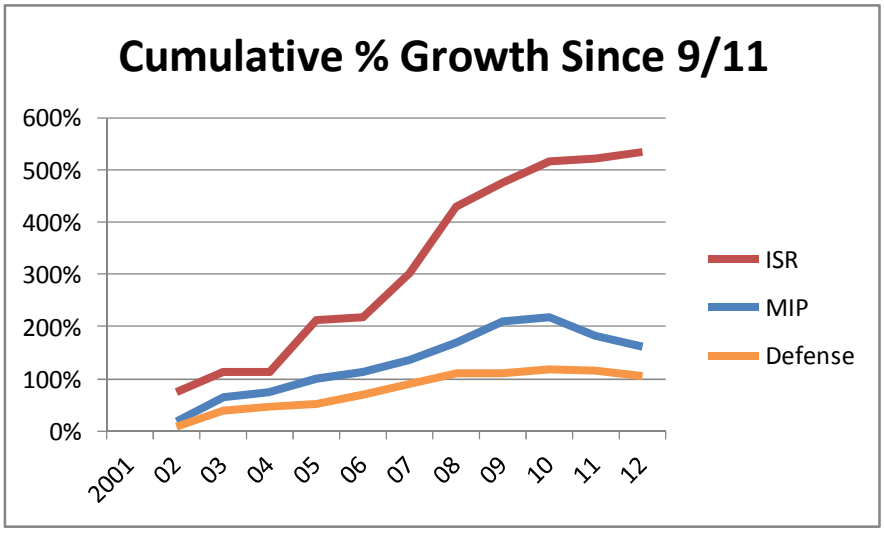
Background

Intelligence, Surveillance and Reconnaissance (ISR)[3] has been invaluable to DoD in protecting its forces and executing operations in Iraq and Afghanistan. ISR systems have given troops critical warning of impending threats and allowed them to locate targets, build an understanding of their patterns of life, and support kinetic operations against them. This success has fueled an exponential growth in demand for ISR over the past decade and a commensurate DoD investment in new and enhanced capabilities.

DoD has spent about $67 billion on ISR since 9/11. Annual ISR spending has more than sextupled in that time period (from less than $1.5 billion in FY 2001 to about $9 billion in FY 2012).[4] The chart below shows how this growth compares to the growth in MIP and overall DoD funding during the same timeframe.



Source: HPSCI staff estimate based on a USDI data call to the Services in January 2012

The number of ISR platforms deployed to theater has increased by 238% since 2008, and there are triple the number of platforms currently in Afghanistan than there were at the height of operations in Iraq.[5] Unmanned aircraft systems (UAS) have constituted the bulk of the growth in ISR spending, multiplying from a total inventory of 167 aircraft in 2002 to more than 7,500 today.[6] They now constitute 1/3 of all military aircraft.[7]

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[3] An activity that synchronizes and integrates the planning and operation of sensors, assets, and processing, exploitation, and dissemination systems in direct support of current and future operations. This is an integrated intelligence and operations function. (DoD JP 2-01)

[4] HPSCI staff estimate based on a USDI data call to the Services in January 2012.

[5] Charts and data provided by the ISR Task Force.

[6] "U.S. Unmanned Aerial Systems," Congressional Research Service, 1/3/2012.

Oversight has not kept pace with the burgeoning investment in ISR. The speed of growth, lack of central management within DoD, and insufficient Executive Branch and Congressional oversight have led to many inefficiencies in DoD's ISR portfolio. Some inefficiency is expected and excusable in a rush to field as much game-changing technology as possible to a war effort. But now is a turning point for two reasons: 1) fiscal pressures have necessitated a contraction in defense spending, and 2) the Iraq war has ended and the Afghanistan war is starting to wind down.

Some inefficiencies are too ingrained to reverse now (e.g. similar unmanned aircraft built separately by different Services; and separate Service schoolhouses to train the operators of these aircraft). But DoD can avoid adding to the existing inefficiency by:

- Cancelling duplicative ISR systems still in development
- Reforming its acquisition process to incorporate cost-benefit analysis
- Enforcing collaboration among the Services on unmanned aircraft training and basing requirements
- Evolving simulated training technology to eliminate costly and unnecessary live training for unmanned aircraft operators

[7] "U.S. Unmanned Aerial Systems," Congressional Research Service, 1/3/2012.

Scope & Methodology

The scope of this performance audit is DoD Intelligence, Surveillance, and Reconnaissance (ISR), with a particular focus on Unmanned Aircraft Systems (UAS). The report is in two parts: ISR Acquisition and UAS Training. Small (hand-launched) UAS are mostly excluded from this study because medium and large UAS consume the bulk of UAS resources. Manned ISR platforms, airships and tethered aerostats were included in the analysis supporting the ISR Acquisition part of the study (though not the focus) but excluded from the Training part.

A few of the recommendations in this report, if adopted, will lead to immediate cost savings in FY 2013. However, most of the recommendations are more focused on helping DoD develop the tools to achieve savings in FY 2014 and beyond.

The analysis in this report assumes that combat operations in Afghanistan will cease and most forces will be withdrawn by the end of 2014. This assumption is in accordance with current Administration policy. In light of the new defense strategy announced in January 2012, the analysis in this report further assumes that some of DoD's strategic focus will shift away from Central Command following the drawdown from Afghanistan.[8] These underlying assumptions lead to the conclusion that many of the ISR assets currently deployed to Afghanistan will be re-deployed to other regional commands. It should be noted that some in DoD disagree with this conclusion, arguing instead that Central Command will remain the top ISR priority even after forces are withdrawn.

Methodology: This performance audit was conducted between late May 2011 and January 2012. Research included:

- Briefings, demonstrations and discussions with senior officials and subject matter experts at: USDI, the ISR Task Force, the Services, the Joint Staff, OSD-AT&L, OSD-P&R, Strategic Command, the FAA, GAO, RAND, Northrop Grumman, Radiant Blue, and IBM Consulting.
- Fact-finding trips to: Fort Huachuca, Fort Gordon, Beale Air Force Base, Creech Air Force Base, Langley Air Force Base, Naval Air Station Patuxent River, Djibouti, and Bahrain.
- Review of reports by GAO, CRS, and CBO.
- Review of DoD policy guidance and budget estimates.

Revision: This report was updated in April 2012 to reflect the FY 2013 President's Budget and DoD's comments on the findings and recommendations.

[8] "Sustaining U.S. Global Leadership: Priorities for 21st Century Defense"

Acquisition

The Department of Defense has invested roughly $44 billion in Intelligence, Surveillance and Reconnaissance (ISR) since 9/11,[1] and plans to spend at least another $27 billion through 2020[2] – all without a strategy for how this investment fits into its future ISR architecture. DoD has allowed the Services to procure their own solutions for joint requirements, leading to duplication and inefficiencies. In light of a tightening budget, DoD will now need to improve its acquisition process to prevent further duplication of effort and right-size the ISR force for future requirements. Meanwhile, most of the assets currently deployed to Afghanistan will return to the United States, and DoD will have to decide which to keep and how to re-allocate them. Combatant Commanders will line up for their piece of the ISR pie and DoD will need to divvy up the assets in a way that maximizes their value within constrained resources. However, DoD currently lacks the process and analytical tools to do this.

Summary of Findings and Recommendations

Finding #1: ***DoD is ineffective at defining and prioritizing its ISR requirements in light of insatiable demand for ISR.*** The Services are inconsistent and imprecise in defining their ISR requirements, focusing on the length of time an aircraft is airborne rather than on the capability it provides relative to its mission. DoD also overstates the demand for ISR by focusing on total unmet requests instead of prioritized requirements.

Recommendation #1a: *The Army should start justifying its ISR procurement requests vis-à-vis its new ISR requirements construct in its Congressional Budget Justification Books, starting with FY 2014.* The Army should demonstrate clearly how it used the Integrated Sensor Coverage Area construct to maximize effectiveness while minimizing cost in its ISR procurement decisions.

Recommendation #1b: *The Air Force should transition from defining its ISR requirements in terms of Combat Air Patrols to a construct more directly linked to mission effectiveness.* The Air Force's CAP metric for defining ISR requirements is incomplete and somewhat arbitrary.

Continued…

[1] HPSCI staff estimate based on a USDI data call to the Services in January 2012.

[2] This only includes continuing planned investment for existing large UAS. The funding for all ISR through 2020 is likely to be much larger. Source: "Policy Options for Unmanned Aircraft Systems," Congressional Budget Office, June 2011.

Recommendation #1c: *ISR requests for Afghanistan should be prioritized according to the Commander of US Forces-Afghanistan's priority intelligence requirements.* Prioritization is key to addressing any ISR shortfalls in theater.

Finding #2: DoD does not use ISR performance data to conduct cost-benefit analyses of acquisition choices, despite the availability of robust data and excellent cost-benefit tools. DoD has resisted the use of a cost-benefit tool, but it may be essential to optimizing ISR resources in flat or declining budgets. Four existing tools are discussed in the table on page 9.

Recommendation #2a: *DoD should develop or acquire an analytic tool that measures an ISR asset's effectiveness against its cost.* The new tool's algorithms should be transparent and neutral, and include the best attributes of the four currently available tools.

Recommendation #2b: *DoD should use its new ISR cost-benefit tool to support analyses of alternatives under the new Joint Staff acquisition process.* Conducting a cost-benefit analysis at the beginning of the process could save money by: changing the concept to reduce costs before DoD is too invested, or choosing a more cost-effective existing program instead.

Finding #3: DoD does not consider value when making decisions about the allocation of ISR assets to COCOMs. When a COCOM does not receive its first-choice ISR asset, the asset it receives instead is not always effective enough to justify the cost of its deployment. Also, the ISR allocation process is not linked to the budget cycle, despite their overlapping timelines.

Recommendation #3a: *DoD should perform a cost-benefit analysis of any ISR allocation to a COCOM that does not fully meet the COCOM's specified requirement.* If the benefit to the COCOM of an ISR asset does not warrant the cost, it should not be allocated.

Recommendation #3b: *The ISR allocation process and budget cycle should be linked.* This could prevent a misalignment between how much ISR is needed to meet DoD's prioritized list of COCOM requirements and how much is provided by Services.

Finding #4: The rapid proliferation of Quick Reaction ISR Capabilities for CENTCOM has resulted in an inefficient approach to meeting mission objectives because investments have been unguided by cost-benefit analyses. In a tightened budget environment, value will be key to the reallocation of these Quick Reaction Capabilities (QRCs) to other COCOMs. DoD's large new ISR inventory has mostly been funded outside the regular budget process, but COCOM use of these assets after 2014 will have to compete with other priorities in DoD's base budget. In addition to the expense of QRCs, they have also led to interoperability problems because common data standards have not been enforced.

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Recommendation #4a: *The Services must conduct lifecycle cost reviews of any ISR quick reaction capability they convert to a program of record.*

Recommendation #4b: *The ISR Task Force should stop sponsoring new initiatives by mid-2013.* Since new quick reaction capabilities take up to 18 months to field, it would be wasteful to start new programs that may never make it to theater before the drawdown.

Recommendation #4c: *DoD should disband the ISR Task Force when most ISR assets are withdrawn from Afghanistan, but retain its rapid acquisition capability.* When ISR has to compete with other priorities in the base budget, DoD will need the capability to analytically maximize the cost-effectiveness of its current ISR inventory, not an advocate for new systems and more deployment of existing systems.

Recommendation #4d: *DoD should conduct a thorough review of which ISR assets should be retained for future requirements and which should be mothballed or sold.* Assets that are not necessary for future requirements and/or not worth the cost of sustainment should be binned into four categories: storage, Reserve Component training, transfer to other government agencies, or sale to foreign partners.

Recommendation #4e: *JFCC-ISR should use the new ISR cost-benefit tool to find the most cost-effective solutions to COCOMs' ISR requests.* Any allocation that is not the most cost-effective option should require OMB approval and Congressional notification.

Recommendation #4f: *All new contracts for ISR QRCs must require adherence to DI2E data standards.* Ensuring that all new ISR systems are interoperable will allow DoD to spend more of its effort on adapting the backlog of QRCs that were not built to standards.

Finding #1: DoD is ineffective at defining and prioritizing its ISR requirements in light of insatiable demand for ISR.

Defining ISR Requirements

The Services are inconsistent and imprecise in defining their ISR requirements. The focus thus far has been primarily on the length of time an aircraft stays airborne rather than on the capability it provides relative to its mission. The Army used to define its ISR requirement by sorties (individual aircraft missions). The Air Force measures its UAS requirements and capabilities in terms of Predator and Reaper orbits or Combat Air Patrols (CAPs): a pattern flown continuously for 24 hours, usually requiring multiple aircraft in shifts. However, ISR capability is not just a function of time – it also depends on coverage area and resolution.

The Army was unsatisfied with the focus on number and time of flights, so it recently adopted a much more rigorous way of defining its ISR requirements: a construct called Integrated Sensor Coverage Area (ISCA). ISCA assumes that the average deployed Brigade Combat Team (BCT) should have enough ISR capability to perform three missions:[3]

1. Persistent Area Assessment (broad area coverage to develop understanding of enemy communications, networks, activities and movements)
2. Situational Development (understanding of target)
3. Mission Overwatch (multi-sensor overwatch in direct support of operations)

This construct loosely correlates to the find, fix, finish paradigm. It was informed by seven years of data the Army collected on how its ISR assets were being used and to what effect. The Army concluded that its average deployed BCT requires the following:

1. One 24 hour/day Persistent Area Assessment covering 100-1600 square kilometers
2. Three 24 hour/day Situational Development capabilities (one per battalion)
3. One 6 hour/day Mission Overwatch capability

Historically, the Services have defined requirements by starting with the platform and asking which sensors could be put on it and what missions it could fly. ISCA is unique because the Army instead started with the mission, asked which intelligence functions it needs to support operations, and stayed agnostic regarding platforms.[4] This kind of approach is more conducive to cost-benefit analysis.

[3] Pre-decisional Army briefing on ISCA, received at Fort Huachuca, 7/13/2011.
[4] Discussion with Terry Mitchell, Army G2 Director of Intelligence Futures, 8/10/2011.

For example, one Persistent Area Assessment is equal to 25 C-12's.[5] In comparison, one Long Endurance Multi-Intelligence Vehicle (LEMV) – an Army airship still in development – could provide a Persistent Area Assessment on its own. Knowing this allows the Army to compare 25 C-12's to one LEMV in terms of performance and cost. Using the CAP/sortie metric, the Army would know how many platforms it could put in the air for a given time period, but it would not be able to define what intelligence capability this translated to. With ISCA, the Army can now start with the required capability and do a cost-benefit analysis of the options that provide that capability.

Recommendation #1a: The Army should start justifying its ISR acquisition requests vis-à-vis ISCA in its Congressional Budget Justification Books (CBJB), starting with FY 2014.

The Army should demonstrate clearly how it used ISCA to maximize effectiveness while minimizing cost in its ISR procurement decisions.

Recommendation #1b: The Air Force should transition from defining its ISR requirements in terms of Combat Air Patrols to a construct more directly linked to mission effectiveness.

The Air Force's CAP metric for defining ISR requirements is incomplete and somewhat arbitrary. It only counts Predator and Reaper flights (despite the existence of several other major Air Force ISR systems) and is not clearly linked to mission requirements.

The Air Force should develop an ISR requirements construct that is linked to mission requirements instead of CAPs and incorporates the contribution of *all* its airborne ISR assets. The construct need not be an Air Force version of ISCA, but should allow the Air Force to make tradeoffs that maximize effectiveness and minimize cost. These tradeoffs should be highlighted in the Air Force's CBJB, starting with FY 2014.

Demand for ISR

The current practice of measuring demand for ISR in unmet requests is not very informative because the desire for information is limitless and commanders will always want eyes on as many targets as possible. A prioritization of ISR requests would be much more instructive in guiding limited resources to ISR gaps. The Joint Functional Component Command for ISR

[5] Either Army's Enhanced Medium Altitude Reconnaissance and Surveillance Systems or Air Force's Project Liberty aircraft.

(JFCC-ISR) – which recommends the distribution of ISR to Combatant Commands (COCOMs) – tracks the proportion of fulfilled high-priority and lower-priority ISR demand, but it does not use this metric. Instead it characterizes the ISR challenge in terms of unmet total demand, which overstates the problem.

JFCC-ISR recommends assignment of ISR assets to the six geographic COCOMs by matching their requests with the assets made available by the Services. JFCC-ISR uses various processes for strategic prioritization and issues an annual plan that allocates all available ISR assets to the COCOMs. It swaps assets between COCOMs throughout the year, but the base allocation is established by the annual blueprint (the Global Force Management Allocation Plan).[6]

COCOM ISR Demand

[Description of COCOM ISR demand on page 1 of the Annex]

CENTCOM ISR Demand

[Description of CENTCOM ISR demand on pages 1-2 of the Annex]

ISR has been invaluable for force protection and the find, fix, finish mission in Iraq and Afghanistan. As deployed units have become familiar with ISR and reliant on it for mission success, CENTCOM demand for it has skyrocketed. There have been many Joint Urgent Operational Need Statements (JUONS) for ISR in the past few years and almost none of them have been denied.[7]

The ISR Task Force – stood up in 2008 by Secretary Gates and given rapid acquisition authority to expand and expedite ISR capability for CENTCOM – has been responsible for most of the new ISR assets rushed to theater in response to warfighters' urgent needs. The ISR Task Force has injected over $10 billion in ISR capability into theater over the past five years, yet the gap between CENTCOM supply and demand remains vast.

Measuring ISR demand in terms of unmet requests is a particularly poor metric for CENTCOM because, unlike the allocation to other COCOMs, ISR requests are not prioritized. According to GAO, DoD does not link ISR requests for Afghanistan to commanders' priority intelligence requirements.[8] DoD's doctrinal guidance on intelligence support to military operations[9] requires any request to fill an identified ISR gap be linked to the commander's priority intelligence requirements. But GAO found that commanders are unable to accurately characterize their ISR shortfalls because they are not measured against the stated priorities.[10] There is a general sense

[6] JFCC-ISR roles and missions briefing, 11/21/2011.
[7] Discussion with Lt Col Adams, J8, 11/16/2011.
[8] Those critical pieces of intelligence the commander must know by a particular time to plan and successfully execute the mission.
[9] Joint Publication 2-01.
[10] GAO-11-224C, 2/23/2011.

that supply is just a drop in the bucket of CENTCOM demand for ISR, but it is unknown whether the highest-priority demand is being met.

Recommendation #1c: ISR requests for Afghanistan should be prioritized according to the Commander of US Forces-Afghanistan's priority intelligence requirements.

This recommendation was made in GAO's February 2011 report on ISR in Afghanistan. DoD disagreed with the recommendation, arguing that ISR mission management is too complex to identify shortfalls against a single metric such as priority intelligence requirements. GAO stood by its recommendation, arguing that it is consistent with joint doctrine and does not preclude DoD from using additional metrics. GAO also noted that existing theater procedures for requesting ISR allow linkages to priority intelligence requirements but that these procedures are not used. For example, one of the ISR mission management tools used in Afghanistan has a place to enter which priority intelligence requirement a request is linked to, but it is often left blank.[11]

GAO's argument appears stronger than DoD's because:

1. DoD's current practice violates its own doctrine.
2. The difficulty of using metrics is not a valid excuse for ignoring them.

Prioritization of ISR shortfalls in CENTCOM may not have been as important in the past because DoD made a great effort to grant as many requests as possible, but with a tightened budget, DoD will need to prioritize and make tradeoffs.

[11] GAO-11-224C, 2/23/2011, pages 6-8.

Finding #2: DoD does not use ISR performance data from Iraq and Afghanistan to conduct cost-benefit analyses of acquisition choices despite the availability of robust data and excellent cost-benefit tools.

DoD's ISR performance metrics do not adequately capture the effectiveness of an ISR platform or sensor against a given mission. DoD does not measure outcomes (e.g. how many high value targets caught due to a given mix of ISR assets), the gold standard of performance metrics. Instead it tends to measure outputs (e.g. how long can a platform stay on station, what is the resolution of the sensor's imagery, or even how many requests were made for a given sensor's data) and anecdotal evidence about what is useful or not in theater.

However, the capability to measure ISR outcomes *is* available to DoD. There are at least four separate efforts to assess the performance of ISR assets, some of which even do full cost-benefit analyses. These four tools are summarized in the table on the next page.

ISR Cost-Benefit Tools						
Tool	**Development/Purpose**	**Inputs**	**Results**	**Benefits**	**Weaknesses**	**DoD Reaction**
Northrop Grumman's Layered ISR Capabilities Effectiveness Tool	• Originally built to guide Northrup's own ISR investment decisions • Cooperative research and development agreement with Joint Forces Command • Licensed to STRATCOM for proof of principle in 2008	• Theater conditions (e.g. terrain), phase of war, mission domains (e.g. air, ground, maritime), and level of effort • Commanders' prioritization (decision-makers have to allocate 100 coins according to their priorities, then allocations are aggregated to form collection requirements) • Platform CONOPs, sensor capabilities, and system performance data • Cost (both base peacetime costs and incremental wartime costs)	• Level of effectiveness (% of decision-maker priorities achieved) for each viable ISR force mix • Rankings of all possible force mixes in terms of pure effectiveness or cost-effectiveness	• Compares existing force mixes to planned/future force mixes to find the most cost-effective solution • DoD could update the data to include all ISR systems and cost, then use it to inform acquisition and allocation decisions	Proprietary algorithms raise suspicion that tool is biased in favor of Northrop's own ISR systems	• OSD lawyers argue it would give Northrop an unfair advantage • Northrop argues it can prove the algorithms' neutrality
Joint Staff's ISR Next Dollar Sensitivity Tool	• Former Vice Chairman Cartwright's tasking in response to GAO finding that DoD lacks a way to prioritize invesments and assess whether additonal capabilities are required • Designed to identify best-value airborne ISR assets • Small team built the tool, two reservists maintain it	• Inventory of all program-of-record airborne ISR platforms and sensors through the FYDP • Services validated attributes of each asset and assigned capability scores • Each attribute ranked by COCOMs and NIMs on a scale of importance from 1 to 10 for 3 scenarios (major combat, irregular warfare and global counterterrorism) • Cost data updated yearly	Identifies most effective platform and sensor for a given intelligence discipline during a given war scenario for the lowest cost per orbit	• Enables rudimentary cost-benefit analysis of acquisition decisions • In-house = unbiased	• Skewed utility data due to most attributes ranked 10 in importance • Does not include all cost data • Does not include quick reaction capabilities	• Has only been used for inventory data and capability comparison in Nunn-McCurdy-like reviews • Has not yet been used to support acquisition or allocation decisions • Most DoD personnel interviewed for this study had not heard of the tool and opposed the idea because the most cost-effective ISR solution is not always the most effective solution
Radiant Blue's BlueSim	Models technical performance of ISR platforms and sensors for the Joint Staff	• Technical attributes of asset • Performance data of asset • Phase of conflict • Target deck	Asseses the technical performance of any ISR architecture against various criteria	Radiant Blue is mostly physicists and their technical modeling capability is well-respected	Model does not include programmatics (e.g. cost, risk, schedule)	Radiant Blue has done studies showing that sensors can be re-configured on certain platforms to obviate the need for a new platform, and studies showing that new programs only out-perform existing programs under unrealistic assumptions. But DoD has a mixed record of acting on this information.
IBM Consulting	USDI relies on IBM for its ISR effectiveness studies	• Asset capabilities • Performance data from Iraq and Afghanistan • Phase of conflict • Target deck	Identifies which mix of ISR assets would be necessary to cover a given area during a given kind of operation	IBM can evaluate the effectiveness of each platform and sensor for counterinsurgency	IBM's current model is not applicable to major combat operations	• Various DoD organizations have sponsored IBM studies of how well ISR assets support operations • But it is unclear whether DoD has used the studies to inform acquisition decisions
Source: Demonstrations/Discussions with Kurt Dittmer (Northrup Grumman), Lee Allen (Joint Staff Deputy Director for Battlespace Awareness), Phil Eichensehr (Radiant Blue), and Frank Strickland (IBM Consulting)						

DoD's use of the tools summarized in the above table has been limited. Many of the DoD subject matter experts interviewed for this study resisted the idea of a cost-benefit analysis tool because it would return results that are not always the most effective solution. The most *cost*-effective solution is not always the most capable system. However, in a time of flat or declining budgets, DoD will not always be able to afford the most capable system. While constrained resources may lead to the acquisition/allocation of some systems that are not as effective as they could be, these local losses in effectiveness could contribute to an improved aggregate ISR capability. DoD has striven for 100%-solutions while its budget has grown steeply in the face of two wars, but as those wars wind down and the budget growth recedes, it may need to pursue less-than-100%-solutions to meet all of its ISR requirements.

Recommendation #2a: DoD should, as soon as possible, develop or acquire an analytic tool that measures an ISR asset's effectiveness against its cost.

An ISR cost-benefit tool is essential to an efficient distribution of DoD's ISR. The Northrop Grumman tool is the most mature and would likely provide the most robust capability to DoD. However, Northrop may need to be more transparent with its proprietary algorithms or otherwise prove its neutrality. The Joint Staff tool has the benefit of being in-house, but it would need to incorporate QRCs and develop a more meaningful asset ranking system. Either tool could benefit from the technical expertise of Radiant Blue and the analytical power of IBM. DoD should develop or acquire a tool with transparent and neutral algorithms that includes the best attributes of the four currently available tools.

Recommendation #2b: DoD should use its new ISR cost-benefit tool to support analyses of alternatives under the new Joint Staff acquisition process.

DoD has often pursued unjustifiably expensive programs because its procurement process did not consider cost early enough in a program's development. Until very recently, cost was not considered until Milestone B of the Joint Capabilities Integration and Development System (JCIDS), DoD's main acquisition process.[12] The problem was that DoD would already be committed to a materiel solution by Milestone B and far enough along on development that it was unlikely to change course.[13] Conducting a cost-benefit analysis prior to the Milestone A decision achieves two things:

[12] The Milestone A decision approves a concept demonstration to fill a capability need; the Milestone B decision approves a materiel solution to the capability need and the start of engineering and manufacturing development; the Milestone C decision approves the start of production and deployment for operational tests.
[13] Discussion with Lt. Col. Jim Adams, J8, 11/16/2011.

1. It eliminates the need to procure a materiel solution if the identified gap can be mostly filled by an existing capability at a much lower cost than a new acquisition.
2. If the cost of the concept considered at Milestone A is prohibitively high and/or not worth the projected benefit, a different concept can be considered before DoD is too invested in the original concept.

The Joint Requirements Oversight Council (JROC) recently reformed the acquisition process such that it must be briefed on all analyses of alternatives before Milestone A. The reformed process will also include more modeling and simulation of proposed new capabilities against various scenarios to analyze the tradeoff between cost and risk.[14] DoD's new Cost-Benefit Analysis Tool would enable faster and more thorough reviews.

The sponsor of any new ISR capability should have to conduct a cost-benefit analysis using the new tool and submit the results to the JROC in support of the Milestone A decision. If a viable alternative to the proposed new capability exists and the analysis shows the alternative to be at least an 80% solution at significantly lower cost,[15] the JROC should reject the new capability in most cases. If a viable alternative does not exist but the projected cost of the new capability is prohibitively high and/or not worth the projected benefit, the JROC should reject it with instructions to find a less expensive solution.

[14] Discussion with Brig. Gen. Richard Stapp, Deputy Director for Requirements, Joint Staff, 3/21/2012.
[15] This is just an illustrative metric. The Joint Staff would need to use its judgment in determining appropriate cost-benefit thresholds.

Finding #3: DoD does not consider value when making decisions about the allocation of ISR to COCOMs.

The base allocation of ISR assets to COCOMs is determined by strategic prioritization, but value is not considered. Strategic prioritization is necessary in the face of very high demand but this approach can be unjustifiably costly when a COCOM's first-choice ISR asset is not available. When a COCOM does not receive an ISR asset that fully meets its specific requirement, the alternate ISR asset it receives is not always effective enough to justify the cost of its deployment. It may sometimes be more cost-effective to allocate the asset to another COCOM that would derive more benefit from it, or to not deploy it at all. However, JFCC-ISR does not do this kind of cost-benefit analysis, despite having an ISR Assessments Group that uses complex models to identify COCOMs' ISR gaps and analyze ISR performance.[16]

Case Study: AFRICOM

[AFRICOM Case Study on page 2 of the Annex]

Recommendation #3a: DoD should perform a cost-benefit analysis of any ISR allocation to a COCOM that does not fully meet the COCOM's specified requirement.

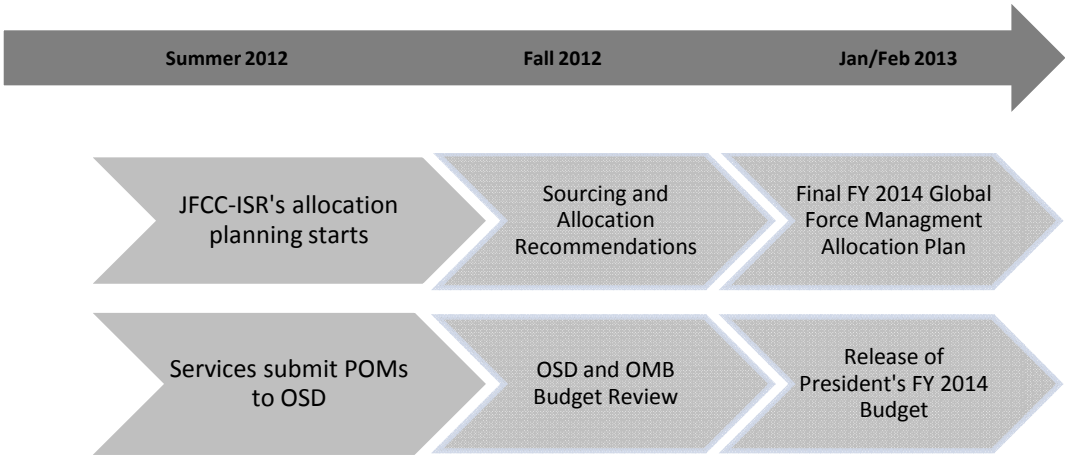
Ideally, DoD would conduct a cost-benefit analysis of all ISR allocations, but at minimum it should take a closer look at ones that are not the COCOM's first choice. If the benefit to the COCOM of an ISR asset does not warrant the cost, it should not be allocated. The Assessments Group in JFCC-ISR should use the new cost-benefit tool discussed in Finding #2 to make these determinations. In the example of the case study discussed under separate cover, if the asset's intelligence value to the COCOM does not warrant the high manning and logistics costs, it should be reallocated to a COCOM that derives more benefit or simply remain in CONUS.

Allocation Not Tied to Budget

The annual ISR allocation process is not linked to the budget cycle, despite starting 16-18 months prior to the year under consideration. Given that the Services complete their Program Objective Memorandum (POM) process around the time JFCC-ISR starts its ISR allocation

[16] Discussion with COL Gould, Director of ISR Operations, JFCC-ISR, 12/9/2011.

planning, it would make sense for them to be linked. The notional FY 2014 timeline below demonstrates the overlap between the budget cycle and ISR allocation cycle:



Currently, the Services offer up the ISR assets they have available for allocation after closing their budget processes and sending their requests to OMB. Availability depends on how much the Services have budgeted for the operating costs of their ISR assets. JFCC-ISR takes the whole available pool of ISR assets not allocated to CENTCOM and divvies them up among the other COCOMs.

When the CENCTOM requirement diminishes, more of the ISR assets the Services budget to operate will be available for global allocation. However, it is not necessarily cost-effective to allocate all of the assets the Services budgeted just because they are available. If the allocation process was linked to the budget cycle, it would allow Services to use JFCC-ISR's strategic prioritization to inform at what level and which assets they fund. When their resources are constrained, the Services may only be able to fund tier 1 and 2 priorities, or fund more platforms with relatively inexpensive operating costs and fewer platforms that are expensive to operate.

The table below demonstrates the range in operating costs of various ISR platforms. It is not an exhaustive list of ISR platforms, but it shows how variable flying hour costs are for different platforms.

Cost per Flight Hour of ISR Platforms*	
($ in thousands)	
JSTARS	49
Rivet Joint	47
Global Hawk	36
U2	30
EP-3	14
Reaper	8
Project Liberty	6

*Does not include PED and other "reachback" costs
Source: HPSCI staff analysis of USDI data

Recommendation #3b: The ISR allocation process and budget cycle should be linked.

JFCC-ISR should coordinate with the Services and OSD at the beginning of its planning cycle so that it can understand the budget constraints on the deployment of ISR assets, and the Services can use JFCC-ISR's prioritized list of COCOM requirements in building their budgets.

Finding #4: The rapid proliferation of Quick Reaction ISR Capabilities for CENTCOM has resulted in an inefficient approach to meeting mission objectives because investments have been unguided by cost-benefit analyses. In a tightened budget environment, value will be key to the reallocation of these QRCs to other COCOMs.

DoD is planning to farm out the huge new ISR inventory currently in Afghanistan to other COCOMs after 2014. However, many of these assets will be much more difficult (or impossible) to operate in countries with limited airspace access or where the military does not have established bases. And some will be too expensive to operate, especially when OCO funding stops and the Services have to make room for these assets in their base budgets. DoD will need an analytical capability focused on value in order to maximize its ISR resources.

The ISR Task Force has sponsored over $10 billion in new ISR capabilities since it was created in 2008.[17] The Task Force is responsible for a 238% increase in ISR platforms over the past five years (FY 2008 – 2012).

All of these Quick Reaction Capabilities (QRCs) have been funded with Overseas Contingency Operations (OCO) funds, almost one-third of which were funded outside the regular budget process by reprogrammings from non-intelligence accounts.[18] The Services are starting to make some of these initiatives programs of record without doing thorough reviews of lifecycle costs.[19] The operating costs of these new programs of record are currently not included in base budgets. When the Services stop receiving OCO funding for these costs, they will have to find room for them within flat or declining base budgets, which may not always be possible.

Recommendation #4a: The Services must conduct lifecycle cost reviews of any ISR quick reaction capability they convert to a program of record.

As the drawdown from Afghanistan commences, Services will need to start folding their ISR quick reaction capabilities (QRCs) into their base budgets. The Army has already announced its intentions to do so with its fleet of tethered aerostats and the Air Force with its Project Liberty aircraft. However, DoD has not established a process to ensure that Services do this in a fiscally sustainable way.

[17] The $10 billion figure understates the cost of the new ISR programs the Task Force has sponsored because it does not include the more mature initiatives that have devolved to the Services.
[18] Funding chart provided by ISR Task Force.
[19] The Air Force's Project Liberty is an example of this. Since a validation process for moving a program from the OCO to a program of record has not been established yet, Services have moved some QRCs to their base budgets without a thorough review.

Any project moved to the Base Budget and deemed a program of record should first have to undergo a thorough review of lifecycle costs. The Future Years Defense Plan should include these estimated lifecycle costs, while the OCO only funds incremental O&M costs directly tied to contingency operations.

The ISR Task Force

DoD has an expedited acquisition process, separate from JCIDS (the regular acquisition process), for urgent warfighter needs. Whereas the JCIDS process takes two to six-plus years, rapid acquisition is completed in 18 months or less. It starts with a Joint Urgent Operational Needs Statement (JUONS) from CENTCOM that is validated by the Joint Staff (J8). The Joint Rapid Acquisition Cell in OSD then assigns a Service to develop a solution. If the need is an ISR capability, the ISR Task Force either starts a new initiative or expands on an existing initiative to meet the need. The Task Force secures the funding, works with the lead Service to field the initiative, tracks its performance and funding execution, and eventually devolves responsibility to the Service.

The Joint Staff has validated almost all JUONS since the beginning of the wars in Iraq and Afghanistan, and the ISR Task Force has focused on getting as much ISR capability to theater as fast as possible. This approach has been instrumental in responding quickly to warfighter needs. However, there has been no cost-benefit analysis and little attention to cost in pushing capabilities to theater. The result is a vast inventory of ISR assets, some of which may not necessarily be best-value investments beyond Afghanistan.

Now that almost all ISR assets have been transferred from Iraq to Afghanistan, and operations in Afghanistan are set to end in 2014, there are two major questions for DoD ISR:

1. At what point should DoD stop initiating new ISR programs for Afghanistan?
2. What should DoD do with all its new ISR assets when they are withdrawn from Afghanistan?

Recommendation #4b: The ISR Task Force should stop sponsoring new initiatives by mid-2013.

Since new quick reaction capabilities take up to 18 months to field, it would be wasteful to start new programs that may never make it to theater before the drawdown. The ISR Task Force has also started slowing the deployment pace of new initiatives in order to deliver more mature

capabilities to theater.[20] This makes 2013 initiatives even less likely to get to theater before the end of 2014. However, an exception should be made for any initiative the USDI determines can be fielded in time to support critical warfighter needs.

Recommendation #4c: DoD should disband the ISR Task Force when most ISR assets are withdrawn from Afghanistan, but retain its rapid acquisition capability.

The ISR Task Force was created for a specific mission: to accelerate and increase the ISR capabilities deployed to Iraq and Afghanistan. The Task Force has been very successful in this mission, but at a high cost that could become problematic in a time of budget austerity. Before his retirement, Secretary Gates decided to fold the formerly independent Task Force into USDI, but Secretary Panetta has yet to decide on the Task Force's future. Lt. Gen. John Koziol, the current director of the ISR Task Force, believes it will be institutionalized,[21] but many in DoD doubt this and are unclear on what an institutionalized Task Force would actually do.

A major part of the ISR Task Force's role so far has been advocacy. It has not just championed ISR in Washington but has also made suggestions to theater on what warfighters may find useful, helping them form requests for additional ISR.[22] The Task Force has also started laying the groundwork for other COCOMs' requests for ISR and planning to shift its focus to these new requests, assuming it will indeed be institutionalized. It has, for example, shared ISR vignettes with AFRICOM and SOUTHCOM so they can start learning about the uses of ISR and thinking about how they would use it.[23]

This advocacy seems to be ingrained in the Task Force's ethos but may not be as appropriate post-combat operations in Iraq and Afghanistan. When ISR has to compete with other priorities in the *base* Defense budget, which may be smaller due to deficit reduction, DoD will need the capability to analytically maximize the cost-effectiveness of its current ISR inventory, not an advocate for new systems and more deployment of existing systems.

The ISR Task Force should be disbanded when its CENTCOM mission ends and replaced by a combination of JFCC-ISR's analytical arm (additional details under Recommendation #4e) and the Joint Staff's new Joint Emerging Operational Needs (JEONS) process. Lessons learned from the Task Force's success need to be incorporated into JFCC-ISR's new emphasis on working with COCOMS to customize existing ISR to their needs, and to the Joint Staff's new JEONS process for rapidly fielding new ISR, to continue a more responsive process than the regular acquisition cycle.

[20] ISR Task Force "Mini-Staffer Day" for HPSCI and SSCI, 12/16/2011.
[21] Discussion with Gen. Koziol, 9/14/2011.
[22] Meeting with ISR Task Force, 10/25/2011.
[23] Gen. Koziol, 9/14/2011.

Recommendation #4d: DoD should conduct a thorough review of which ISR assets should be retained for future requirements and which should be mothballed or sold.

OSD should conduct or commission a study to evaluate each ISR asset in Afghanistan against future defense needs.[24] It should consider the operations and sustainment costs of each asset, including the cost of maintenance and necessary upgrades for future use. Assets that are not necessary for future requirements should be binned into one of two categories:

1. Other Government Agencies – The asset could be transferred to other agencies, including the Department of Homeland Security or state and local governments.
2. Foreign Military Sale – The asset could be sold to a foreign partner.

Assets that are not worth the current cost of sustainment for potential future requirements should be binned into one of two categories:

3. Mothball – The asset should be broken down and put into storage.
4. Reserve Component – The asset should be partly shifted from the active duty force to Reserve Component units in case it is needed in the future.

Category 1 could be a particularly good option for ISR assets that require permissive airspace, such as aerostats and airships. Whereas it may be difficult for a COCOM to operate these assets in another country's airspace, the Border Patrol, for example, may be able to use them for persistent surveillance of the Southwest Border. And if DoD finds any of its UAS excess to need, it would find a growing market of US agencies interested in unmanned aircraft, including the Department of Energy, Department of Transportation, FEMA and the Forest Service. Category 2 could be a good option for assets that will be replaced by more advanced programs of record, especially in light of a growing international market for unmanned ISR.

Any decisions about ISR force structure that result from OSD's study should be published in DoD's next ISR Integration Roadmap[25] and briefed to Congressional defense and intelligence committees. OMB should track transfers of assets to other government agencies and sales to foreign partners. In order to incentivize transfers and sales of unneeded assets, OMB should consider giving the DoD component budgetary credit for half the O&M previously budgeted for an asset in the year following its transfer/sale.

[24] The National Academies of Science has offered to conduct such a study and submitted an unsolicited draft proposal.

[25] An NDAA-required document produced every few years by USDI that is supposed to include a development and integration strategy of ISR assets over a 15-year period. In reality it is an inventory of ISR capabilities that has yet to include an architectural strategy.

Recommendation #4e: JFCC-ISR should use the new ISR cost-benefit tool to inform decisions about the re-allocation of ISR assets.

When most ISR assets are withdrawn from Afghanistan and COCOMs start making requests for ISR from a much-expanded inventory, JFCC-ISR's purview and workload will increase substantially. The cost-benefit tool discussed in Finding #2 will help JFCC-ISR make allocation decisions about the pool of ISR assets not mothballed or sold. The Assessments Group within JFCC-ISR should use the tool in addition to its Force Allocation Decision Model to find the most cost-effective solutions to COCOMs' requests. It should also consider new configurations of sensors that maximize a platform's effectiveness.

For example, if SOUTHCOM requests a platform that can stay up for 12-plus hours and has Ground Moving Target Indicator (GMTI)-cued Full Motion Video (FMV) that can penetrate through canopy, JFCC-ISR could put these parameters into the cost-benefit tool and have it spit out feasible force mixes. If it turns out that configuration 1 is the 99% solution but costs twice as much as configuration 2, which is the 80% solution, JFCC-ISR should generally recommend configuration 2 for SOUTHCOM with few exceptions. If it turns out that there is a more cost-effective sensor combination that still meets the mission objectives, JFCC-ISR should recommend allocating that instead.

Any allocation included in the Global Force Management Allocation Plan that is *not* the most cost-effective option should require OMB approval and Congressional notification. Any reprogramming request that funds the emergency re-allocation of an ISR asset should require documentation of its cost-effectiveness or justification for not allocating the most cost-effective solution. Since above-threshold reprogrammings are already reviewed by OMB and the Congress, running a proposed emergency allocation through the cost-benefit tool should not significantly delay the process.

Data Standards for ISR Information Sharing

In addition to the expense of QRCs, they have also led to interoperability problems within and among Services. Many of the sensors currently in CENTCOM were developed so rapidly to meet urgent warfighter needs that there was little consideration of how to format the data they produced. The result was ISR data from the various sensors being downloaded into each Service's Distributed Common Ground System (DCGS)[26] in incompatible formats. This made it difficult for a DCGS analyst to fuse intelligence from disparate sensors and search for the data he needed because they were all in different formats.

[26] The Processing, Exploitation and Dissemination system for ISR data.

Interoperability challenges led to the advent of "widgets" that can integrate ISR data from incompatible sensors. The Services and Combat Support Agencies have also started building software applications that translate the data from non-standard sensors to understandable formats.

The effort to translate ISR that was not built to standards appears to be going well. However, if ISR data standards are not enforced, DoD will continue to fall behind each time it builds a new non-standard sensor. DoD policy is to build all new program-of-record sensors to common data standards, but there is no overarching DoD policy on building QRC sensors to standards.

USDI's solution to the data standards issue is a framework called the Defense Intelligence Information Enterprise (DI2E). DI2E specifies a set of common data standards, governs compliance with them, and provides applications to translate non-standard data.[27] DI2E is currently being operationally tested in COCOMs' Joint Intelligence Operations Centers (where COCOM ISR is processed and analyzed). The effort is a step in the right direction because it will enforce a common set of standards. But it is important that DoD not fall further behind by allowing new QRC sensors to ignore the DI2E standards.

Recommendation #4f: All new contracts for ISR QRCs must require adherence to DI2E standards.

Adherence to standards should be a key performance parameter for any new ISR sensor program. Ensuring that all new ISR systems are interoperable will allow DoD to spend more of its effort on adapting the backlog of QRCs that were not built to standards.

[27] DI2E briefing, USDI, 9/9/2011.

Unmanned Aircraft System Training

Operator training for the current inventory of Unmanned Aircraft Systems (UAS) is unsustainable due to cost and airspace constraints. It is also inefficient due to stove pipes among Services and platforms. These challenges are partly a product of lagging technology and partly of poor coordination among Services. However, there are opportunities on the horizon to consolidate training for new systems with existing training programs and to develop technology that heads off an impending training crisis. The future of Intelligence, Surveillance and Reconnaissance (ISR) is increasingly unmanned. If DoD is to maintain a cadre of well-trained UAS operators, it needs to stay ahead of the inevitable "peace dividend" training cuts and airspace shortages by making the right investments now.

Summary of Findings & Recommendations

Finding #5: ***DoD lacks a comprehensive strategic plan for UAS training and is not aggressively pursuing one.*** Despite legislative requirements, a GAO report, and DoD's recognition that it needs a strategic plan, DoD is still about two years from delivering one. When operations in Afghanistan end the training requirement for UAS in CONUS will increase significantly and, if training policies are not in place by then, it could seriously degrade UAS readiness.

Recommendation #5a: *DoD should accelerate its development of a comprehensive strategic plan for UAS training.* It should include: standards for the mix of simulated and live training, basing criteria, and a cost comparison of technological solutions to integrate UAS into the national airspace.

Recommendation #5b: *The Navy and Air Force should re-consider who can qualify to be a UAS operator.* It may be less expensive but equally effective for the Air Force to use enlisted operators and the Navy to use non-rated pilots and/or enlisted operators.

Recommendation #5c: *DoD should pursue efficiencies in its UAS training footprint by co-locating future UAS with existing UAS fleets.* The Navy in particular has an opportunity for basing efficiencies and should consider joint and/or consolidated bases for its myriad future UAS.

Continued…

Finding #6: ***DoD does not have access to all the airspace it will need to train Unmanned Aircraft System operators when combat operations in Afghanistan end.*** UAS can only access the national airspace through FAA waivers, which currently constrains training. If the FAA does not develop safety standards for UAS, allowing them to train in national airspace without waivers, DoD will have trouble maintaining UAS readiness when most UAS return to CONUS.

Recommendation #6a: *DoD should build on its existing investment in ground-based air traffic control systems and the most cost-effective sense and avoid technology to integrate UAS into the national airspace.* Since DoD will have to over-build sense and avoid technologies in order to gain FAA approval, it is especially important to consider cost earlier than usual in the acquisition cycle.

Recommendation #6b: *DoD should find ways to substitute UAS simulated training for live training.* UAS are particularly suited for simulated training. And increasing the amount of training completed in simulators is likely the best way for DoD to live within tightening airspace and budget constraints.

Finding #7: ***UAS simulators are not as effective as they could be due to lagging technology and challenges with interoperability.*** Simulator realism has not kept pace with current technology, and many simulators cannot link to each other for training exercises that involve a mix of aircraft. Also, there is no DoD policy on how much training should be simulated and no strategic plan to make better use of simulators.

Recommendation #7a: *DoD's strategic plan should include how to expand the use of simulators for UAS training and reduce the number of live training hours.* The plan should set quantitative and ambitious goals for the percentage of UAS training achieved in a simulator. An adequate training simulator should also be a key system attribute in any new system's capabilities description document.

Recommendation #7b: *DoD should increase its investment in maturing the interoperability and quality of simulated UAS training.* Additional R&D funds should be authorized in the FY 2013 Intelligence Authorization Act for this purpose, offset by one of the cuts recommended in the acquisition portion of this study.

Finding #5: DoD lacks a comprehensive strategic plan for UAS training and is not aggressively pursuing one.

UAS training requirements will increase in the coming years due to expanding inventories and the return of many UAS to the continental US (CONUS). And since the vast majority of the UAS procured in the past 10 years have been deployed most of the time, there is not enough space for them at existing UAS bases in CONUS. However, the Government Accountability Office (GAO) found in a 2010 study that DoD is not planning strategically for how to meet the increased training requirements and basing challenges. The GAO report noted that DoD has various studies underway on how to improve UAS training, airspace access, basing decisions and training support, but that there is no comprehensive UAS training strategy to guide the prioritization of resources.[1]

The House Armed Services Committee's (HASC) 2011 Defense Authorization report directed DoD to describe the Services' plans to support their current and planned UAS inventories by the time it delivered its FY 2012 Budget. This report was not delivered with the Budget but DoD has formed a "tiger team" to study the issue. The 2012 Intelligence Authorization classified annex includes [unclassified] language directing the Undersecretary of Defense for Intelligence (USDI) to finish this study, including a strategy for achieving efficiencies.

A meeting with the head of training policy for the Office of the Secretary of Defense-Personnel & Readiness and USDI, almost two years after GAO's call for a UAS training strategy, revealed that DoD is still studying the need for a strategy but has not made much progress on drafting one.[2] A full spectrum UAS training strategy may take up to two more years to develop, according to this DoD official.

Recommendation #5a: DoD should accelerate its development of a comprehensive strategic plan for UAS training.

UAS training challenges will only worsen in the next two years. If a strategic plan is not released well before the return of ISR assets from Afghanistan to CONUS, DoD may not be able to avoid a training crisis. Within a year, DoD should finalize a strategic document that includes:

- DoD-wide training requirements and standards for the mix of simulated and live training
- Standardized basing criteria and supporting infrastructure requirements

[1] "Unmanned Aircraft Systems: Comprehensive Planning and a Results-Oriented Training Strategy are Needed to Support Growing Inventories," GAO, March 2010.
[2] Meeting with Frank DiGiovanni, Director of Training Readiness and Strategy, 10/28/2011.

- A cost comparison of potential technologies that would allow UAS to operate in the national airspace for training purposes

Enlisted vs. Officer

The Services each have different policies on whom they train to be UAS operators, which significantly affect cost. The Army has established a new career field for UAS operators and trained 720 new UAS operators in FY 2011 alone. All operators are enlisted and there is no distinction between the "pilot" and sensor operator. The Marine Corps also uses enlisted operators and cross-trains them to be a "pilot" or sensor operator. The Air Force and Navy both use enlisted sensor operators and officer "pilots" but the Air Force has established a new career field for UAS "pilots" while the Navy has not. The Navy looked into establishing a career field but opted instead to continue using rated pilots to operate its UAS.[3]

The average training savings from establishing a career field for Air Force UAS "pilots" is $500,000 per pilot, according to a 2008 audit.[4] This is because it only costs $135,000 to train a UAS pilot compared to $2.6 million to train a fighter pilot or $600,000 to train an airlift pilot. The aggregate training savings of the new career field (including fuel savings) is $1.5 billion over six years, according to this analysis. If the Air Force started training enlisted airmen to operate UAS instead of pilots, it could save even more since officer basic pay is roughly double enlisted basic pay.

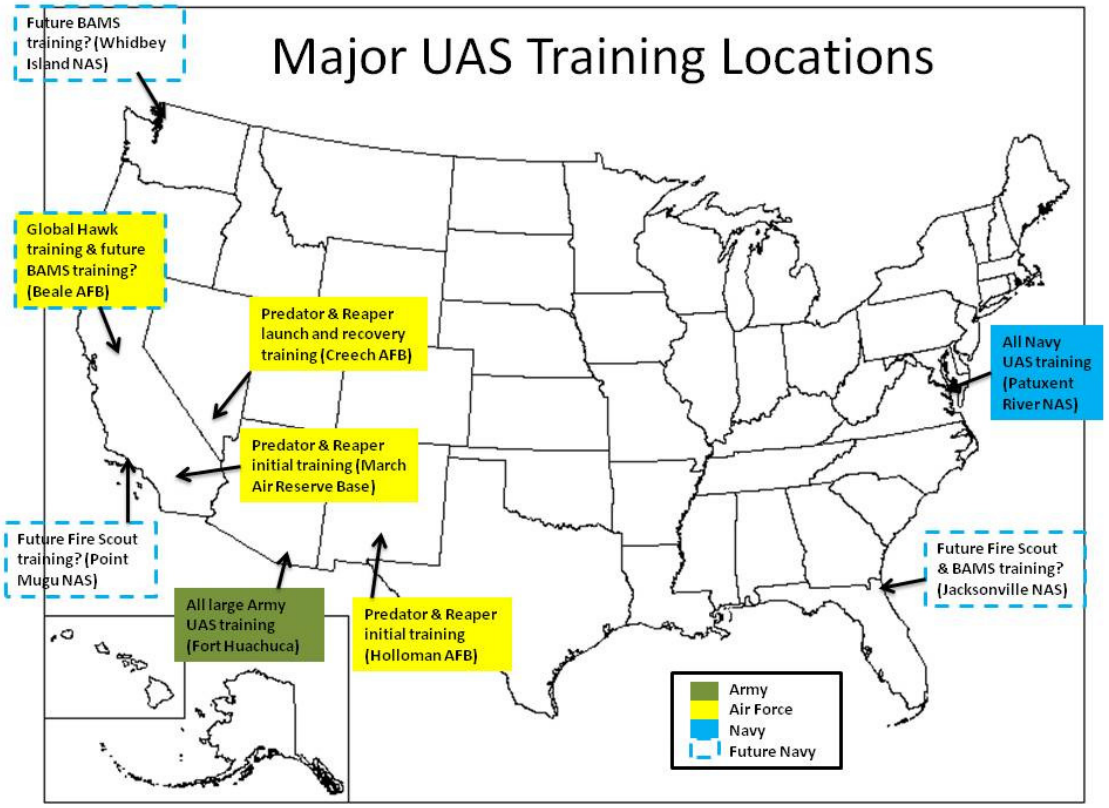
Recommendation #5b: The Navy and Air Force should re-consider who can qualify to be a UAS operator.

The Navy and Air Force should study the Army and Marine Corps' experience with enlisted UAS operators and evaluate whether adopting such a model would degrade mission performance. The Navy should also calculate how much it would save if instead of rated pilots its UAS operators were (1) officers who are not rated pilots or (2) enlisted personnel. And the Air Force should calculate how much it would save if instead of officers its UAS operators were enlisted personnel. Both Services should conduct a cost-benefit analysis and change their policies if the benefits outweigh the costs.

[3] Services and USDI UAS training subject matter experts briefing, 5/25/2011.
[4] "Unmanned Aerial System Pilot Force Management," Air Force Audit Agency, 12/17/2008.

Dispersed Basing

DoD has not established criteria for UAS basing decisions, leading to a fairly ad-hoc Army and Air Force UAS basing and training posture. As shown in the below map, the Army was able to consolidate most of its UAS training on Fort Huachuca (AZ) but the Air Force UAS training is geographically dispersed. Navy UAS training is only temporarily consolidated while its two systems undergo operational testing, but its future footprint may also be fairly dispersed.



Recommendation #5c: DoD should pursue efficiencies in its UAS training footprint by co-locating future UAS with existing UAS fleets.

It would be difficult to consolidate Air Force UAS training at this point because the various training bases have built supporting infrastructure. However, the Air Force should capitalize on existing UAS bases for its future UAS. And all Services should consider their own and each others' existing UAS bases instead of establishing new bases as they expand their inventories.

The Navy presents the greatest opportunity for efficiencies in its basing footprint because it has yet to finalize basing decisions for its existing UAS or even consider basing in its acquisition decisions about future UAS. Navy's Broad Area Maritime Surveillance (BAMS) UAS and Fire Scout are still in operational testing and are temporarily based at Patuxent River (MD). Unfinalized plans include the following basing arrangements:

- BAMS based in Jacksonville and Whidbey Island (WA), as well as several locations outside CONUS.
- The Navy has a memorandum of agreement with the Air Force to conduct initial operator training on the BAMS at Beale AFB with the Global Hawk training squadron.[5]
- BAMS sensor operator training will be separate (location TBD) from the Air Force due to sensor differences between the BAMS and Global Hawk.
- Fire Scout will be based in Jacksonville and San Diego.

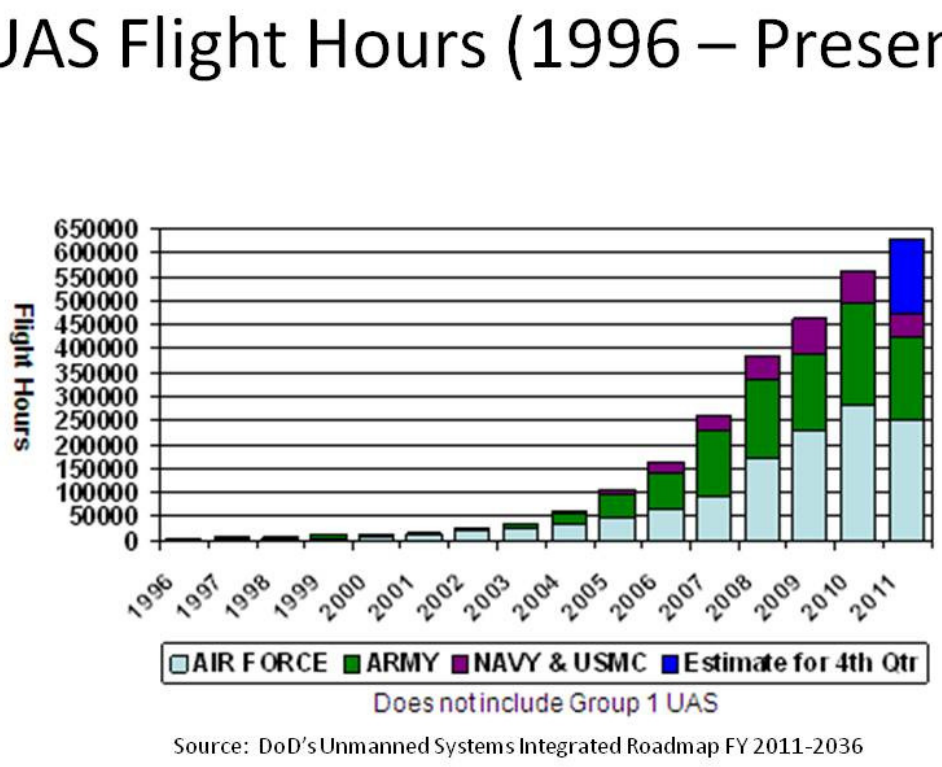
The Navy is planning to buy two future unmanned aircraft systems and is in a different stage of development with each. Navy should prioritize basing and training considerations in its acquisition decisions on these future systems. For example, basing should be a key system attribute in the capabilities description document for future systems so that airspace constraints and infrastructure efficiencies are considered early in the acquisition process.

Likewise, the Navy should consider its future systems in the final basing plans for BAMS and Fire Scout. For example, the Navy should consider whether Jacksonville, Whidbey Island and San Diego have space to grow and access to enough airspace to accommodate future systems.

[5] It is not yet clear how this arrangement will be affected by the Air Force's decision in the FY 2013 President's Budget to terminate the Global Hawk Block 30 program.

Finding #6: DoD does not have access to all the airspace it will need to train Unmanned Aircraft System operators when combat operations in Afghanistan end.

UAS flight hours have grown dramatically from around 25,000 in FY 2001 to over 600,000 in FY 2011 (see chart below). About 90% of these hours were flown in direct support of combat operations. Less than 10% were flown in CONUS.[6] As combat operations decrease, the CONUS portion of those flying hours will have to increase significantly in order to keep UAS "pilots" and sensor operators trained on all the new systems. Many initial qualification and advanced training hours are currently flown in theater by teaming up a new operator with a more experienced one. Continuation training (necessary for keeping operators qualified) is simply not done currently because of the operating tempo. If all the "training" hours that are currently flown in theater are going to be absorbed into CONUS, DoD will need to address the current constraints on training in national airspace.



[6] Joint DoD-FAA briefing to HPSCI, HASC and Aviation Subcommittee on UAS Airspace Integration, 9/26/2011.

Restricted vs. National Airspace

UAS do not currently meet federal regulations on safe aircraft separation and collision avoidance for routine access to the national airspace. This significantly constrains UAS training in CONUS. Many UAS bases have restricted airspace (reserved for military use) but they have to compete with other aviation units on the base. Training facilities have already outgrown their restricted airspace and the huge growth of military UAS will only worsen this problem. [7]

In addition to the shortage of restricted airspace, there are also training exercises that require flying UAS over particular geographic features (e.g. mountains) outside the military's restricted airspace or flying from one piece of restricted airspace to another through national airspace. When the military needs to fly in national airspace, it has to go through the Federal Aviation Administration (FAA). In these cases, it must obtain a certificate of authorization (COA) by proving to the FAA that it will mitigate any safety risk to other planes in the airspace and people on the ground.

Regulatory Environment

The problem is the COA process can take up to a year and the burden is on the military to prove its UAS will not hit non-cooperative air traffic or small planes that do not need authorization to fly below certain altitudes. However, the FAA does not have a consistent analytic framework to determine whether enough risk has been mitigated to warrant a COA. It issues the COAs on a case-by-case basis and often requires a visual observer to track the UAS. In many of these cases, the military has to fly a chase aircraft to maintain visual line of sight. The FAA requires visual line of sight because its rule that pilots must be able to see and avoid other aircraft is still based on the human eye. However, flying a chase aircraft likely increases the risk of collision, according to DoD (not to mention that it is costlier and unsustainable given the growth in UAS training).

There are three requirements for UAS operating in the national airspace: [8]

1. Airworthiness of the aircraft (certified by DoD),
2. "Pilot" qualification (DoD sets the training standards), and
3. Regulatory compliance

Compliance with FAA regulation is difficult because the FAA does not yet set specific and permanent rules for safe operation of UAS. Therefore, military UAS do not satisfy the third requirement (regulatory compliance) because there is currently no way to do so. This "Catch-22" leaves DoD in the position of needing a one-off waiver for each training mission that utilizes national airspace.

[7] Meeting with Dyke Weatherington, Deputy Director of Unmanned Warfare (OSD AT&L), 6/15/2011.
[8] DoD's "Unmanned Aircraft System Airspace Integration Plan Version 2.0," March 2011.

The Need for Standards

DoD argues that if the FAA issued standards for separation and safety (i.e. how close a UAS is allowed to come to another aircraft and how quickly it must act to avoid collision), the COA process would be less ad-hoc and go more smoothly. Better yet, DoD could build UAS to the FAA-mandated standards. However, FAA has made no move to pro-actively develop standards and its 12-person unmanned program office has become increasingly overwhelmed by DoD COA requests.

There have been various legislative efforts to fix this problem, including language in the 2009 National Defense Authorization Act creating an interagency task force to study the problem of integrating UAS into the national airspace. FAA, DoD, NASA, and the Department of Homeland Security have been meeting in this forum for over a year but have made very little progress.

As an illustrative data point: When HPSCI, HASC and the Aviation Subcommittee invited DoD and FAA to brief any progress on airspace integration, FAA's primary example of progress was a proposed rule on small UAS.[9] This rule would require visual line-of-sight operations for all small (hand-launched) UAS in the national airspace. The FAA hopes to publish the final rule by mid-2013. Since there will be a standing rule on the use of small UAS in national airspace, DoD will no longer need COAs to train with them. However, the new rule simply enshrines the somewhat arbitrary requirement of a human observer instead of establishing performance safety requirements. It also fails to address large UAS.[10]

Legislative Solution

The FAA Reauthorization Act enacted in February 2012 directed the FAA to integrate UAS into the national airspace. This is the critical passage:

> "Not later than December 31, 2015, the Secretary [of Transportation] shall develop and implement operational and certification requirements for operational procedures for public unmanned aircraft systems in the national airspace system." [11]

This requires the FAA to develop and implement standards for military UAS operating in the national airspace, which would enable DoD to build UAS to the requisite standards and skip the COA process. While this requirement constitutes major progress, and has been four years in the making, UAS standards still will not be in place until 2016 at the earliest.

[9] Small UAS are generally hand-launched.
[10] More recently, the FAA agreed to extend military UAS COAs from 12 months to 24 months, which is an improvement but not a solution.
[11] H.R. 658, Sec. 324, paragraph (b).

Most military UAS will likely be out of CENTCOM years before 2016 and UAS operators will have to be trained in CONUS to maintain proficiency and mission readiness. These training exercises will also have to compete for airspace with manned training missions. If there are no rules in place by then, and DoD has to keep relying on the COA process to train its UAS operators, it will put substantial strain on both DoD and FAA.

Technological Solutions

DoD has both a short-term and long-term plan for UAS training in light of airspace constraints. The short-term plan is to improve and expedite the current COA process. The long-term plan is to develop aircraft that comply with Federal Aviation Regulations (FAR). However, it is difficult to build a FAR-compliant aircraft when FAA has yet to define the requirements. DoD's plan is to build aircraft with the most mature "sense and avoid" technology possible, certify them as FAR-compliant, and ask FAA for operational approval to fly without a visual observer.

There are two options for UAS sense and avoid technologies: ground-based and airborne. Currently, the most promising ground-based option is an array of 3D radars that can sense when anything enters the airspace and track it. Most military airfields currently have these systems for air traffic control. However, there are filters on the system that remove "clutter" such as slow-moving objects or birds. The Marine Corps believes it can take the pre-filtered feed and pipe it to UAS ground control stations so that the operator can see and avoid anything that comes near his aircraft. This concept will be tested at Marine Air Station Cherry Point and may prove to be the most cost-effective ground-based solution.[12]

DoD is also developing an airborne sense and avoid solution for UAS that cannot use ground-based radars because they fly at high altitude or over water. Northrop Grumman is currently testing a 3-pound radar for the nose of a BAMS UAS. The system would be equipped with algorithms that detect objects within a certain radius and sense their direction so that the aircraft automatically avoids collision. However, this kind of airborne solution is expensive, limited by weight and power, and not yet miniature enough for small UAS.[13]

DoD sees the need to address the sense and avoid problem as inevitable because it will become more important for UAS operations when DoD does not own the airspace as it did in Iraq and Afghanistan. Assuming UAS are assigned to various other Combatant Commands in the future, they will need to integrate into other countries' airspace. Not having a sense and avoid

[12] Discussion with Dallas Brooks, Chair of the Unmanned Aircraft Systems Airspace Integration IPT at OSD AT&L, 12/1/2011.
[13] Dallas Brooks.

capability will potentially make this integration even more difficult than accessing US national airspace.

Recommendation #6a: DoD should build on its existing investment in ground-based air traffic control systems and the most cost-effective sense and avoid technology to integrate UAS into the national airspace.

DoD's plan to develop the most advanced sense and avoid capabilities possible and deem them FAR-compliant is an expensive and risky prospect. Until the FAA issues guidance on sense and avoid requirements, DoD will have to over-build its technology demonstrations in order to prove to the FAA that they work. Since this is a particularly expensive endeavor, DoD should consider cost earlier than usual in the acquisition cycle. There is a package of airspace integration technologies currently at the pre-Milestone A phase of the Joint Capabilities Integration Development System. Before a Milestone A decision is made, the most cost-prohibitive solutions should be eliminated in favor of cost-effective solutions that have a high likelihood of FAA approval. This should be easier to do under the Joint Requirements Oversight Council's new process for considering pre-Milestone A acquisitions (discussed on page 11 of this report).

Recommendation #6b: DoD should find ways to substitute UAS simulated training for live training.

One way to live within growing airspace constraints is to do more UAV training in simulators. Simulated training does not require any airspace. And after the initial investment in the simulator, the operations costs are significantly less than the cost of fuel and maintenance associated with live training. This recommendation is also covered below in Finding #7.

Finding #7: UAS simulators are not as effective as they could be due to lagging technology and challenges with interoperability.

UAS are particularly well-suited for simulated training because there is no physical difference to the operators between a live exercise and a simulated exercise. In both cases, the "pilot" and sensor operator sit next to each other in a trailer watching sensor feeds and using computers to control the aircraft and sensors. Since they never physically lay eyes on the aircraft, they have no way of knowing whether a training exercise is live or a good simulation.

Yet there is currently no strategic planning for how to make better use of simulators in anticipation of an increase in CONUS UAS training after combat operations end.[14] Nor is there a DoD policy on how much UAS training should be simulated. Some Services have notional policies on the mix of simulated and live training and some Services have yet to address this issue. None of the notional policies is particularly well-justified and some Service-level policies are inconsistent with platform-specific policies. For example: [15]

- The Army's unofficial policy is that up to half of UAS training can be simulated.
- Most of the training for Army's Shadows and Hunters is currently done in simulators but less than half of the larger Grey Eagle (similar to Predator) training is simulated.
- The Air Force now does about 70% of *initial* training in a simulator but wants to reach 100%.
- The notional Air Force goal for *all* training (initial, advanced and continuation) specifically on Predator and Reaper is 50% simulated, 25% live, and 25% actual combat flying hours.

There will always be reasons to fly some live UAS training missions, e.g. having a "hot bird" for maintainers to train on and working out the nervousness any pilot feels from flying a real aircraft. However, some of the reasons DoD gives for needing live training, such as practicing following a vehicle on a road and shooting weapons, seem more like a product of lagging technology than the inherent weakness of simulators. If simulation technology were better, training scenarios would be so life-like that most live training may not be necessary.

Simulated training technology has lagged as the UAS inventory has expanded. Investments simply have not been made in advancing simulator technology because the focus has been on getting more ISR capability to theater as quickly as possible. Simulated full motion video (FMV) feeds are "cartoonish" and advanced features, like heat signatures and true randomness,

[14] Conversation with Greg Kern (subject matter expert on UAS at USDI), 4/25/2011.
[15] Services and USDI UAS training subject matter experts briefing, 5/25/2011.

are difficult to simulate.[16] There is plenty of recorded FMV from real operations but the problem with using it for training scenarios is that it is static (the trainer and trainee cannot dynamically interact with the mission).

Many simulators are not interoperable with each other, making distributed training involving a mix of manned and unmanned assets impossible.[17] To provide full training fidelity, it is important for unmanned aircraft simulators to be able to link to manned aircraft simulators to rehearse close air support and strike coordination & armed reconnaissance (SCAR) missions. The UAS role in these missions is to support a manned attack aircraft by providing target information, sometimes laser-guiding munitions from the manned attack aircraft ("buddy-lasing"), and assessing battle damage after the manned attack aircraft has left the scene. If unmanned simulators cannot link to manned simulators, these training exercises cannot be simulated.

Recommendation #7a: DoD's strategic plan should address expanding the use of simulators for UAS training and reducing the number of live training hours.

DoD directive 1322.18 on military training, issued at the beginning of 2009, states that simulated training should be the first alternative to live training.[18] Perhaps this policy should be reversed for UAS since they are so well-suited for simulation. This directive or a new directive specific to UAS training should also set ambitious goals for increasing simulated training and decreasing live training. OSD P&R and USDI would first need to issue a data call of the Services to find out what percentage of training is currently simulated for each of their UAS. One argument against setting goals for the percentage of simulated training is that technology development makes it a moving target. However, setting quantitative and aspirational goals could incentivize progress towards more realistic UAS simulated training.

The feasibility of adequate training simulators should also be a key system attribute in any new system's capabilities description document. This would emphasize the importance of simulators early in the acquisition process and prevent training from being a tradable attribute when procurement is over-cost.

[16] Meeting with Frank DiGiovanni, Director of Training Readiness and Strategy, 10/28/2011.
[17] "Unmanned Aircraft Systems: Comprehensive Planning and a Results-Oriented Training Strategy are Needed to Support Growing Inventories," GAO, March 2010.
[18] Paragraph 4, sub-paragraph (f)

Recommendation #7b: DoD should increase its investment in maturing the interoperability and quality of simulated UAS training.

Higher quality UAS simulators that are interoperable with each other and manned aircraft simulators do not seem out of reach. Video games currently on the market are nearly indistinguishable from live action, so with additional development it should be feasible to improve the realism of simulated training and turn recorded FMV into dynamic scenarios. And there is already software that links some simulators to each other so it should be feasible to develop standards for linking all or most simulators to each other. Smart investments and a policy that encourages more simulated training will help prevent an impending UAS training crisis and save money in the future.