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ADVANCED CONCEPT TECHNOLOGY DEMONSTRATIONS (ACTD): ARE THEY RELEVANT IN TODAY'S ACQUISITION ENVIRONMENT?

by

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14. ABSTRACT
The Department of Defense (DOD) implemented the Advanced Concept Technology Demonstration (ACTD) process in 1994 as an alternative to the more traditional, overly bureaucratic acquisition system in place throughout the 1970s and 1980s. Many senior leaders in the Office of the Secretary of Defense (OSD) and the services heralded the process as an important component of DOD?s acquisition reform revolution. Nevertheless, did the system really provide significant results beyond what the acquisition system could provide? Before 1996, the ACTD?s purpose was to fill a void in the existing acquisition process by transitioning emerging technologies to the warfighter faster and cheaper than acquisition policy and regulation allowed. Now that the new DOD 5000 directives provide significant regulatory relief governing current acquisition programs, is the ACTD process still viable or has it become irrelevant? This paper compares the current DOD 5000 acquisition process with the ACTD process and examines three ACTDs, all Unmanned Aerial Vehicles, to determine if the ACTD process produced results that could not be expected in today's reformed acquisition environment. What the research shows is that for major weapon system development efforts, the ACTD program does not offer substantial benefits. In fact, the ACTD process creates problems the traditional acquisition process was designed to prevent.

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Preface

This paper examines the utility of the existing Advanced Concept Technology Demonstration (ACTD) process for major weapon system development and test efforts in light of DOD acquisition reforms. It describes the ACTD process in terms of goals and fundamental themes used to guide individual programs. The paper also explores specific Unmanned Aerial Vehicle (UAV) ACTD efforts to determine if they produced results over and above, those expected from the sometimes-bureaucratic mainstream acquisition system. The paper's scope was limited in that it considered issues from only the UAV ACTDs in the hopes that the dollar value and complexity of these case studies make their study relevant to DOD's other major weapon system development efforts.

I have spent my entire Air Force career in the acquisition field, including a tour in the Pentagon, and saw the bureaucracy firsthand. In fact, I became part of it. The ACTD process intrigued me since it apparently removed many roadblocks. I wanted to know if it was a viable acquisition strategy, and if it was then what were its advantages? What I found was a process that initially was very unique; however, over time has developed its own set of problems and become redundant to the reformed acquisition system.

I wish to acknowledge the assistance and express my sincere gratitude to my Air Command and Staff College research advisor, Major Courtney Holmberg. He stepped right up, took a genuine interest in my work, and continued as my mentor from that first E-mail.

Abstract

The Department of Defense (DOD) implemented the Advanced Concept Technology Demonstration (ACTD) process in 1994 as an alternative to the more traditional, overly bureaucratic acquisition system in place throughout the 1970s and 1980s. Many senior leaders in the Office of the Secretary of Defense (OSD) and the services heralded the process as an important component of DOD's acquisition reform revolution. Nevertheless, did the system really provide significant results beyond what the acquisition system could provide? Before 1996, the ACTD's purpose was to fill a void in the existing acquisition process by transitioning emerging technologies to the warfighter faster and cheaper than acquisition policy and regulation allowed. Now that the new DOD 5000 directives provide significant regulatory relief governing current acquisition programs, is the ACTD process still viable or has it become irrelevant? This paper compares the current DOD 5000 acquisition process with the ACTD process and examines three ACTDs, all Unmanned Aerial Vehicles, to determine if the ACTD process produced results that could not be expected in today's reformed acquisition environment. What the research shows is that for major weapon system development efforts, the ACTD program does not offer substantial benefits. In fact, the ACTD process creates problems the traditional acquisition process was designed to prevent.

Chapter 1

Introduction and Thesis

We must continue to ensure our soldiers, sailors, airmen, and marines are fully capable of fulfilling their required tasks with equipment that is engineered to provide superior mission performance as well as safety and reliability.

—Joint Vision 2010

The United States is in the midst of a technology revolution where state-of-the-art military systems can become obsolete very quickly.[1] In the late 1980s and early 1990s, the Department of Defense (DOD) acquisition system made it difficult to get high tech hardware into the hands of the operators before it was superseded by systems that were more capable. DOD clearly needed a more responsive procurement system. An "acquisition reform revolution" began, but it would be a long time before the policy and culture would change. While the Department wrestled with new streamlining initiatives and a sweeping rewrite of the DOD 5000 series procurement directives, it also implemented a bold new process called the Advanced Concept Technology Demonstration (ACTD). This new enterprise, led by the Office of the Secretary of Defense's (OSD) Advanced Technology Directorate (DUSD/AT), bypassed the bureaucratic acquisition system in an attempt to rapidly deliver new prototype weapon systems to our nation's warfighters. In turn, the warriors, not the technocrats in Washington, would determine if the latest technology would indeed prove valuable.

However, today, four years after DOD initiated the ACTD process and two years after DOD streamlined the acquisition regulations, it appears many ACTD tenets are included in the new DOD 5000 acquisition process. Innovation is encouraged and program managers are taught to use their best judgement instead of following a strict "paint by the numbers" approach. Commercial products, best practices, Cost as an Independent Variable (CAIV), Integrated Process Teams (IPTs), rapid prototyping, and early operational assessments are just a few of the program management tools now encouraged in the DOD 5000 regulations.[2] Both the ACTD process and the mainstream acquisition system use these techniques to manage and mitigate program risks.

Years of experience, lessons learned, and traditional acquisition approaches survived the test of time and remained in the DOD 5000 acquisition framework to mitigate risks inherent in major weapon system development efforts. The ACTD process, on the other hand, is just now revealing what can go wrong when too much emphasis is placed on rapidly fielding a prototype weapon systems and to little attention is given to long term objectives. Case studies will later show how some ACTD development efforts experienced significant costs and schedule growth due to software and integration problems. Other ACTDs did not place enough emphasis on requirements development, training, and supportability issues. As DOD incorporates lessons learned from these and other ACTDs in an effort to correct recurring problems, the process improvements are making the ACTD process and their acquisition strategies look more and more like traditional acquisition programs.

Since DOD incorporated major tenants of the ACTD process into the traditional acquisition system, and the DOD 5000 acquisition process mitigates recurring ACTD problems, there is no reason DOD should continue developing major weapon systems in the ACTD process. To support this thesis, this research paper will first describe why the DOD initially created two separate weapon system development processes. Chapter 3 will highlight ACTD goals, themes, and processes to determine if there are any unique aspects of the ACTD program that are not already captured in the mainstream acquisition system. Chapter 4 presents UAV ACTD case studies and identifies issues the DOD encountered as it developed theses weapon systems. As a group these UAV ACTDs were highly complex weapon systems representative of major DOD development programs (the ACTD process labels them Class II[3]). Therefore, the Chapter 5 conclusions about ACTD programs apply only to the largest ACTD efforts—the ones DODD 5000.2-R would define as major defense acquisition programs (Acquisition Category (ACAT) IC or ACAT ID) or major acquisitions (ACAT II).[4]

Notes

[1] Department of Defense, *Joint Vision 2010*, (Washington, D.C.: Joint Chiefs of Staff, 1996), 7.

[2] Paul G. Kaminski, Under Secretary of Defense (Acquisition and Technology), Office of the Secretary of Defense, memorandum to the Defense Acquisition Community, subject: Update of the DOD 5000 Documents, 15 March 1996.

[3] "ACTD Transition Guidelines," (Deputy Undersecretary of Defense for Advanced Technology web site document, n.d.), n.p.; on-line, Internet, 10 December 1997, available from http://www.acq.osd.mil/at/transtoc.htm.

[4] DOD Regulation 5000.2-R, *Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs*, 6 October 1997, part 1, 2-3.

Chapter 2

Finding a Home for Reform and Innovation

The real penalty for inefficiency is not just wasted dollars, but unmet demand for military capabilities.

— Global Engagement: A Vision for the 21st Century Air Force

A Failed DOD Procurement System

In the past, many characterized DOD's acquisition system as overly bureaucratic, rigid, and wasteful. Consequently, the President formed a Blue Ribbon Panel, the Packard Commission, in 1986 to analyze the defense acquisition system and make specific recommendations for improving it.[1] Indeed, the Commission concluded, "…the defense acquisition system has basic problems that must be corrected. These problems are deeply entrenched and have developed over several decades from an increasingly bureaucratic and over regulated process."[2] The Packard Commission said it took too long to develop and field major weapon systems, and the unreasonably long cycle time led to unnecessarily high costs. They recommended "a high priority on building and testing prototype systems to demonstrate that new technology can substantially improve military capability."[3] Furthermore, they suggested, "Operational testing should begin early in advanced development, using prototype hardware."[4] Primarily because of the Packard Commission findings, the DOD acquisition system slowly began the process of change.

The remaining sections of this chapter will describe the creation of the ACTD program and the acquisition reform revolution.

Changing the Process

ACTD Beginnings—A Success Story

In early 1994, the ACTD program was "introduced to help revolutionize the DOD acquisition process…"[5] It was going to cut cycle time by transferring "mature technologies rapidly from the developers to the users."[6] DOD responded to the Packard Commission's report and implemented the process which quickly prototyped new technology so operational forces could evaluate it early--before DOD committed to a full-blown acquisition program. The idea seemed simple. Operators would take experimental systems into the field for two-year operational demonstrations.[7] If the user liked the demonstrator and only wanted a few, the new system could be replicated and "bypass the Pentagon's lengthy and costly acquisition procedures."[8] If the system required further development or if a large quantity was required, the ACTD would provide the "basis for a realistic set of requirements with which to enter the more structured and formal acquisition process."[9]

In 1995, after twenty-two ACTDs were initiated, Dr. Paul Kaminski, Under Secretary of Defense for Acquisition and Technology (DUSD and A&T)) said, "I intend to continue to increase the department's emphasis on ACTDs. I believe it is a critical initiative to improve our response time, our cycle time, to support our operational warfighter needs, and to decrease the time and cost to get new capabilities fielded."[10] The President's 1995 National Security Science-Technology Strategy also was optimistic and recognized ACTDs as one of several "new ways of conducting the business of defense."[11] Today a variety of ACTDs exists (see Appendix A) to ensure our 21st Century warriors are armed with technologically superior equipment. Thus, in just a short time, ACTDs evolved from a simple idea inside OSD acquisition circles to an innovative way of meeting our post-cold war challenges. As these changes were taking shape, the larger, more traditional, acquisition system was also about to explode in a frenzy of new reform.

Acquisition Reform Revolution

By 1996, DOD cemented acquisition reform initiatives in a completely new version of the acquisition bible—DOD Directive 5000.1 and its companion, DOD Regulation 5000.2-R. These updates fundamentally altered the philosophical approach program directors and pentagon staffs used to manage acquisition programs. No longer was a cookbook approach mandated. In its place were minimum requirements, sometimes dictated by law, that placed new emphasis on tailoring each program's acquisition strategy, program management techniques, and oversight to match individual program's needs. In congressional testimony, Dr. Kaminski said, "The new policy and procedures resulting from DOD's initiative to rewrite the DOD 5000 series represents dramatic change in almost every major aspect of the way DOD traditionally does business."[12]

Program acquisition strategies now relied on tailored management approaches, Integrated Product Teams (IPTs), commercial products, best commercial practices, and innovation to achieve success. The DOD 5000 directive no longer mandated a one-size-fits-all approach.[13] In fact, it required Program Managers to streamline all acquisitions so that they contain only those requirements that were essential and cost-effective.[14] In total, DOD based this new acquisition system on a "simplified and flexible management process, modeled on sound business practices."[15] Dr. Kaminski, in congressional testimony said, "what I find is that the system is not broken—it fields equipment that is second to none in the world…but the system can and must operate much more efficiently."[16]

Co-existing Systems

Today, both the ACTD and the DOD 5000 acquisition systems exist to develop manufacture and test new military weapon systems. By design, the DOD 5000 regulations do not govern the ACTD process; however, the documents recognized ACTDs as a "non-traditional acquisition" technique.[17] Between the two systems, a great deal of commonality exists--especially between ACTDs and the Program Definition and Risk Reduction (PDRR) phase of the acquisition cycle. Like ACTDs, DOD 5000 regulations encourage rapid and early prototyping as a method of reducing risk during the PDRR phase of an acquisition program. DODD 5000.1 says, "Prototyping, demonstrations, and early operational assessments shall be considered and included as necessary to reduce risk so that technology, manufacturing, and support risks are well in hand before the next decision point."[18] So, what are the differences between an ACTD and the early prototyping demonstrations advocated during the PDRR phase of traditional major acquisitions? The next chapter will explore this question by considering ACTD goals and processes and their relationships to the mainstream acquisition system.

Notes

[1] Larry Lynn, "Advanced Concept Technology Demonstrations: Today's Technology for the Warfighter," *Army RD&A*, September-October 1995, 4.; on-line, Internet, 10 December 1997, available from http://155.219.30.130/st/LLYNN.HTM

[2] Packard Commission. *A Report to the President on Defense Acquisition, A Formula for Action*, (Washington, D.C., April 1996), 5.

[3] ibid, 18.

[4] ibid, 18.

[5] Lynn, 5.

[6] ibid, 5.

[7] Philip J. Klass, "Military Users To 'Try Before Buying,'" *Aviation Week and Space Technology*, 18 April 1994, 24.

[8] ibid, 24.

[9] Lynn, 5.

[10] "Pentagon invests $1 billion in ACTDs," *Aviation Week and Space Technology*, 31 July 1995, 55.

[11] "1995 National Security Science–Technology Strategy: New Ways of Doing Business," n.d., n.p.; on-line, Internet, 10 December 1997, available from http://www.whitehouse.gov/WH/EOP/OSTP/nssts/html/chapt2-2.html#mm18

[12] Paul G. Kaminski, Statement of The Under Secretary of Defense for Acquisition and Technology before the Acquisition and Technology Subcommittee of the Senate Committee on Armed Services on Defense Acquisition Reform, Washington, D.C., 19 March 1997, n.p.; on-line, Internet, 10 December 1997, available from www.acq.osd.mil/ousda/testimonies/def_acq_reform.html.

[13] Paul G. Kaminski, Under Secretary of Defense (Acquisition and Technology), Office of the Secretary of Defense, memorandum to the Defense Acquisition Community, subject: Update of the DOD 5000 Documents, 15 March 1996.

[14] DOD Regulation 5000.2-R, part 3, 12.

[15] Kaminski, memorandum to the Defense Acquisition Community, 3.

[16] Kaminski, Statement before the Acquisition and Technology Subcommittee, n.p.

[17] DOD Directive 5000.1, *Defense Acquisition*, 15 March 1996, 5.

[18] DOD Regulation 5000.2-R, part 1, 5.

Chapter 3

ACTD Goals and Process

ACTD Goals

Depending on the source and audience, different ACTD goals emerge. From the OSD staff perspective, the "primary goal...is to evaluate the military utility of mature advanced technology(s), and to develop the concept of operations that will optimize effectiveness."[1] To justify ACTD funding requests, a budget document stated, "the goal is to provide credible data on operational utility as the basis for acquisition decisions."[2] In an interview, Dr. Kaminski said ACTDs are "designed to test market new fighting concepts."[3] While the ACTD goal are different for different participants in the process, four recurring themes emerge that, on the surface, seem to distinguish ACTDs from traditional acquisition approaches.

ACTD Themes

Rapid Technology Transition. Joint Vision 2010 stresses the importance of successfully migrating advanced technology to the warfighter. It states,

> This era will be one of accelerating technological change. Critical advances will have enormous impact on all military forces. Successful adaptation of new and improved technologies may provide great increases in specific capabilities. Conversely, failure to understand and adapt could lead today's militaries into premature obsolescence and greatly increase

> the risks that such forces will be incapable of effective operations against forces with high technology.[4]

Joint Vision 2010 goes on to specify that ACTDs will be part of the "implementation process" which will "promote the integrated development of operational capabilities" by the "CINCs, Services and joint organizations." More rapid technology transition to the warfighter is certainly one theme of the ACTD process.

Early Field Demonstrations. ACTDs exists to rapidly transition new technology, in the form of fieldable prototypes, to the warfighter so he can evaluated the system in a robust, and highly integrated military field exercise. Similar to the way DOD 5000 acquisition programs conduct operational testing (OT) from an operator's perspective, ACTD demonstrations are the avenue for declaring whether or not the new technology provides a significant benefit to the warfighter. The principal difference is that acquisition programs place emphasis on the engineering or development test (DT) results. Conversely, all that really counts in an ACTD is the warfighter's assessment of the system performance during operational field demonstration.

Warfighter Involvement. ACTDs also join the operational sponsor and materiel development organizations together like no other acquisition process. The warfighting sponsor, normally a CINC like USACOM, is not only responsible for evaluating military utility of the system and making a final recommendation for post-ACTD efforts; he is also responsible for working through every step of the ACTD process with the system developer.[5] In DOD 5000 acquisitions, users also play an important role, but in reality, it's a secondary role—especially after the requirements are developed. OSD's ACTD guide says, "since the ACTD involves the developer, the user, and the operational test community working in concert, there is a good understanding not only of the critical operational requirements, but also of the cost, schedule, and risk sensitivities to variations in the operational requirements. This environment produces an informed buyer."[6]

Residual Capability. Unlike most acquisition programs, at the end of an ACTD the hardware and software are available to the warfighter as a residual operational capability.[7] The operational unit can use the system for training in anticipation of production hardware, as a limited operational capability, or use it to further define and refine requirements and operational concepts. In an ACTD, operators can anticipate OSD will provide two years of funding to sustain the residual capability in the field.[8] The interim operational capability is not unique to the ACTD process. A few ongoing traditional acquisition programs, like Airborne Laser and JSTARS, incorporated the concept and provided residual operational capabilities during their development process.[9,10] However, since every ACTD is planned to provide a residual capability, it is clearly a significant ACTD theme.

So far, this chapter identified four macro-level themes (rapid technology transition, early field demonstrations, greater user involvement, and residual capability) that are central to the ACTD program. Although the ACTD process clearly emphasized these areas as its trademarks, these themes are not entirely unique since the DOD 5000 acquisition process similarly advocates insertion of leading edge technologies, prototype testing, early operational assessments, and effective communication with the operational users.[11,12] The next section will further develop this thought by analyzing recognized differences between the ACTD and the DOD 5000 acquisition processes.

ACTD Process

ACTD Process Differences

Defense Systems Management College (DSMC) at Fort Belvoir, Virginia is responsible for training DOD's acquisition work force. Their acquisition policy course material compared ACTD and traditional acquisition processes (see Appendix B) to highlight the differences between the two systems. They identified prototyping, funding, and oversight as three principal distinctions between ACTDs and traditional acquisition prototyping efforts. The course material stated:

1. "[P]rototypes are designed to a systems specification and respond to performance characteristics in the Operational Requirements Document (ORD)." "…ACTDs need not conform to specifications in a requirements document."[13]
2. "Acquisition programs must be fully funded across the 6-year Future Year Defense Program (FYDP) by Milestone I. [ACTDs] are funded only in the years necessary to accomplish the R&D objectives" and to "operate the ACTD in the field for at least 2 years."[14]
3. ACTD top level oversight is provided by the Advanced Technology Breakfast Club (see Appendix C for membership list) and an additional oversight group chaired by DUSD(AT).[15]

The next three sections discuss these differences and show that, in practice, the two processes really are not significantly different for major weapon system development efforts.

Prototype Requirements. DSMC's course materials implied the acquisition system requires contractors build prototypes to exacting systems specifications to meet an array of performance requirements documented in an ORD. In reality, however, DODD 5000.1 and its companion regulations do not require prototypes conform to system specifications or require contractors test prototypes to ORD performance requirements. Prototyping is encouraged during the Program Definition and Risk Reduction (PRRR) phase of an acquisition program as “multiple concepts, design approaches, and /or parallel technologies are pursued.”[16] Just like an ACTD, the prototypes are used as a tool to reduce risk and make sure engineers develop a system the users want.

ORDs are in development during the PDRR phase and during ACTDs. OSD’s ACTD guide indicates requirements “evolv[e] from a mission need and associated performance goals at the start of the ACTD to a formal ORD and/or a system performance specification at the conclusion of the ACTD…”[17] Just like a mainstream acquisition program, user’s operational performance parameters are developed early in the ACTD process. The ACTD Management Plan, which should be approved before the contractor starts an ACTD, commonly states the weapon system’s Measures of Effectiveness (MOE) and Measures of Performance (MOP).[18] Appendix D contains an example from the High Altitude Endurance (HAE) Unmanned Aerial Vehicle (UAV) Management Plan. In addition, another ACTD document, the Implementation Directive, typically includes these “operational parameters by which military effectiveness is to be evaluated.”[19] OSD, the Joint Staff, and the supporting CINC approve both of these formal documents before the ACTD begins. Therefore, the initial ACTD planning typically scopes the weapon system performance parameters and then refines the parameters as the government/contractor team gains experience developing the system. During the ACTD, the draft ORD serves as a vehicle to further document the user’s requirements and approve them through the Services and the Joint Staff.

The DODR 5000.2-R requirement development process for an acquisition program is not significantly different.

> System performance objectives and thresholds shall be developed from, and remain consistent with, the initial broad statements of operational capability. The requirements shall be refined at successive milestone decision points, as a consequence of cost-schedule–performance trade-offs during each phase of the acquisition process.[20]

Beginning at Milestone I, the decision point which establishes a new acquisition program, "thresholds and objectives initially expressed as measures of effectiveness or performance and minimum acceptable requirements…shall be documented by the user…in an Operational Requirements Document."[21] At Milestone I the ORD is considered an initial ORD and often contains "TBD" parameters to encourage performance trades and refinement.[22] Key concepts outlined in DODR 5000.2-R describe this requirement development process as:

1. keeping all reasonable options open and facilitating trade-offs throughout the acquisition process;
2. avoiding early commitments to system-specific solutions, to include avoiding early commitments to solutions that inhibit future insertion of commercial off-the-shelf equipment or components;
3. defining requirements in broad operational capability terms; and
4. using minimum acceptable operational performance (thresholds) to establish operational test criteria.[23]

The requirements generation process for both system attempts to provide a great deal of flexibility to the engineers building the prototype systems while baselining minimum operational performance requirements in formal program documents.

Funding. ACTD program managers must obtain ACTD and any follow-on acquisition funding through the Planning Program and Budgeting System (PPBS) just like traditional acquisition program managers. While traditional acquisition programs should be fully funded in the Future Years Defense Plan (FYDP), ACTD programs are not required to include funding for post-ACTD activity in the FYDP.[24] At first glance this benefit of not funding additional research and development (R&D) or any production effort may appeal to the Services and OSD in a fiscally constrained environment; however, it is not practical and creates problems as ACTDs transition to acquisition programs.

In reality, post-ACTD financial planning must be accomplished during the ACTD since the acquisition Milestone Decision Authority (MDA) will only transition the program from an ACTD to an acquisition program if the follow-on effort is fully funded.[25] This dichotomy is a recognized problem within the acquisition community since it affects not only the ACTD and its follow-on acquisition effort, but also other modernization programs competing for the same scarce funding. OSD's ACTD guidelines offer three alternative strategies.[26] First, the services can appeal directly to OSD's Defense Resources Board (DRB) to include funding for the follow-on acquisition effort. If this brute force method is successful, it means OSD will transfer funding from an approved program to the new ACTD follow-on effort. This strategy disrupts the formal PPBS process by inserting new funding requirements very late in the process after priority and funding issues should have previously been resolved within the services.

The second alternative suggests the acquisition strategy contain a two-year gap between the completed ACTD and the beginning of the formal acquisition process.[27] This gap allows program managers time to obtain funding through the normal two-year PPBS process. While this suggestion creates efficiency within the PPBS process, it is likely to break the program and cause its cancellation due to the increased contractor shut down and startup costs.

The third, and probably most attractive solution offered, is to assume success.[28] If the acquisition strategy includes this course of action, the services must insert an acquisition cost estimate into the PPBS process before the ACTD testing is complete and before the user has had an opportunity to make an operational assessment. Unfortunately, not having the test results will build uncertainty into the cost estimate and increase the funding wedge since results obtained in the last year or two of the ACTD are arguably the most relevant. During this critical time DOD will determine the production configuration, the type of funding required (R&D vs. Production), and the scope of any future effort. Consequently, the Services may be reluctant to fund any follow-on effort given the ACTD's unpredictable future.

So in the end, although the funding rules are different between the two systems, PPBS reality dictates ACTD programs must plan and program follow-on acquisition funding in the FYDP to maintain program stability. ACTD program managers and the service headquarters must incorporate their budgets into the PPBS—just like traditional acquisition programs.

Oversight. ACTDs and acquisition programs both rely on multi-disciplinary IPTs to provide oversight, resolve issues, and make major program decisions.[29] The names of the groups are different, but they are organized and function in a similar fashion. In both systems, program managers interface with their formal chain of command and IPT oversight groups. A graphical depiction of both groups' decision making process is provided in Appendix E.

Originally, ACTDs bypassed the largely bureaucratic Pentagon oversight process. However, over time lessons learned from the initial cadre of ACTDs demonstrated the need for additional program management, oversight, and documentation requirements.

As ACTD requirements grew, the process became more and more like the mainstream acquisition system.

UAVs are a prime example of this trend. The Air Force Scientific Advisory Board (SAB) reviewed the UAV ACTD acquisition strategy and strongly supported it in the hopes that it would provide "a method of shortening the time to demonstrate a system operationally."[30] They felt, however, that these are "technology demonstrations heavily concentrated on engineering solutions" and that the "long-term life-cycle concerns [were] often ... neglected."[31] Reliability, maintainability, and supportability aspects of the program needed attention.[32] They also found that "event-driven milestones with coordinated entrance and exit criteria [were] required"[33] as the programs proceeded through their various phases. The SAB also felt that threats were not being adequately addressed and that a "System Threat Assessment Review would be important for downstream decisions on configuration, force, size, and production."[34] They also believed ACTD program managers should place greater emphasis on end-to-end modeling and simulations and more disciplined flight test approaches.[35] These recommendations directly supported the call for more traditional risk mitigation techniques in the ACTD process.

The level of DOD oversight increases even more as a program prepares to transition into the mainstream acquisition system. This transition process received increased attention recently, and is becoming more structured as a result of ACTD lessons learned. OSD's ACTD transition guide now suggest ACTDs expecting to transition to production should develop an interoperability plan; a life cycle cost estimate; support plan; reliability, maintainability, and availability (RM&A) requirements; and a formal transition IPT.[36] In addition, ACTDs must involve the operational test and evaluation (OT&E) community so they can prepare an independent assessment before production (to meet Title 10 U.S. Code requirements).[37] Although these activities reduce the risk of an unsuccessful transition, they not only increase ACTD bureaucracy and program costs, but also add time to the development process.

Chapter Summary and Conclusions. The goals and themes of ACTDs center around developing, prototyping, and demonstrating new technology in real world operational environments with the intent of further developing or producing that new technology in an acquisition program. These efforts are very similar to Program Definition and Risk Reduction development and prototyping efforts, especially if the operational test community provides an early assessment. DSMC identified distinctions between the ACTD and acquisition prototyping processes, but over time the prototyping, funding, and oversight differences have become smaller as the acquisition process became more flexible and the ACTD system more ridged.

The next chapter will present UAV case studies to identify specific issues DOD is experiencing with ongoing ACTD efforts.

Notes

[1] "Guidelines for ACTD Management Plans," (Deputy Undersecretary of Defense for Advanced Technology web site document, n.d.), n.p.; on-line, Internet, 10 December 1997, available from http://www.acq.osd.mil/at/a3.htm.

[2] "RDT&E Budget Item Justification Sheet (R-2 Exhibit): Advanced Concept Technology Demonstrations," (OSD FY 1996 President's Budget documentation, Washington, March 1996), 2.

[3] "Reengineering The Acquisition Process, An Interview With Dr. Paul G. Kaminski, Under Secretary Of Defense For Acquisition and Technology," *Armed Forces Journal International*, June 1997, 54.

[4] Department of Defense, *Joint Vision 2010*, (Washington, D.C.: Joint Chiefs of Staff, 1996), 7.

Notes

[5] "ACTD Transition Guidelines," (Deputy Undersecretary of Defense for Advanced Technology web site document, n.d.), n.p.; on-line, Internet, 10 December 1997, available from http://www.acq.osd.mil/at/transtoc.htm.

[6] "ACTD Transition Guidelines," (Deputy Undersecretary of Defense for Advanced Technology web site document, n.d.), n.p.; on-line, Internet, 10 December 1997, available from http://www.acq.osd.mil/at/transtoc.htm.

[7] Kaminski, Statement before the Acquisition and Technology Subcommittee, n.p..

[8] "ACTD Transition Guidelines," n.p..

[9] David A. Fulghum, "USAF Sees New Roles For Airborne Laser," *Aviation Week and Space Technology*, 7 October 1996, 26.

[10] Eric H. Biass and Roy Braybrook, "Northrop Grumman Joint Stars," *Armada International*, May 1997, 52.

[11] DOD Regulation 5000.2-R, *Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs*, 6 October 1997, part 3, 6,17.

[12] DOD Directive 5000.1, *Defense Acquisition*, 15 March 1996, 6.

[13] Jim Sheldon, "Role of Science and Technology Activities," (Defense Systems Management College, Acquisition Policy Department Teaching Note, Acquisition Policy Advanced Program Management Course (APMC) 97-1, 1 December 1996), 71.

[14] ibid, 71.

[15] ibid, 71.

[16] DOD Regulation 5000.2-R, part 1, 5

[17] "ACTD Transition Guidelines," n.p..

[18] "Guidelines for ACTD Management Plans," n.p..

[19] "Guidelines for ACTD Implementation Directives," (Deputy Undersecretary of Defense for Advanced Technology web site document, n.d.), n.p.; on-line, Internet, 10 December 1997, available from http://www.acq.osd.mil/at/a2.htm.

[20] DOD Regulation 5000.2-R, part 2, 2.

[21] DOD Regulation 5000.2-R, part 2, 3.

[22] DOD Regulation 5000.2-R, appendix II, 1.

[23] DOD Regulation 5000.2-R, part 2, 2.

[24] "Guidelines for ACTD Management Plans," n.p..

[25] DOD Regulation 5000.2-R, part 2, 6.

[26] "ACTD Transition Guidelines," n.p..

[27] "ACTD Transition Guidelines," n.p..

[28] "ACTD Transition Guidelines," n.p..

[29] "Guidelines for ACTD Management Plans," n.p..

[30] P. Worch, *Report on UAV Technologies and Combat Operations*, United States Air Force, Scientific Advisory Board Report SAB-TR-96-01 (Washington, D.C.: AF Scientific Advisory Board, November 1996), 9-4.

[31] ibid, 9-4.

[32] ibid, 9-4.

[33] ibid, 9-4.

[34] ibid, 9-4.

Notes

[35] ibid, 9-4
[36] "ACTD Transition Guidelines," n.p..
[37] DOD Regulation 5000.2-R, 3-16.

Chapter 4

DOD's Recent Unmanned Air Vehicle Acquisitions

> *[DOD] UAV acquisition efforts to date have been disappointing. Since Aquila began in 1978, of eight UAV programs, three have been terminated (Aquila, Hunter, Medium Range), three remain in development (Outrider, Global Hawk, DarkStar), and one is now transitioning to low rate production (Predator). Only one of the eight, Pioneer, has been fielded as an operational system. We estimate DOD has spent more than $2 billion for development and/or procurement on these eight UAV programs over the past 18 years.*
>
> —Louis J. Rodrigues, Director Defense Acquisition Issues, GAO

UAV Background

UAV Acquisition History

UAV acquisition programs are not new. Since the 1950s, the Armed Forces, recognizing their unfulfilled potential, pushed technology to advance UAV capabilities. Unfortunately, only a few systems became operational with any real degree of success. The apparent failure of our UAV weapon system development efforts are primarily attributed to historically poor user support for the weapon systems due to competition from manned systems and a failed acquisition system.[1] It was not until the Israelis successfully used their Scout and Mastiff UAV systems against Syria in the 1982 Lebanon conflict that the United States reconsidered the viability of UAVs and began a renewed quest with heightened expectations.[2,3]

DOD did not develop the Pioneer UAV, which is the only fully operational UAV system in today's U.S. inventory, using the traditional acquisition process. Based on the Israeli UAV successes, the Navy and Marine Corps began an expedited procurement of Pioneer (an Israeli Mastiff UAV variation) by skipping the traditional development phase and moving directly into production.[4,5] The DOD encountered unanticipated problems almost immediately.[6] General Charles C. Krulak, Commandant of the Marine Corps, said,

> Unfortunately, the Pioneer has too many limitations. First, the Pioneer does not have an automatic take-off, landing, or mission execution capability that has led to a high accident rate. Second, since the UAV telemetry is calculated at a Ground Control Station (GCS) that is incapable of integrated data dissemination, we lose the ability to pass this information quickly to the units that need it. Third, because it lacks weatherproofed avionics and has no Synthetic Aperture Radar (SAR) capability, the Pioneer is useless in bad weather.[7]

By 1990, the Navy completed a $50 million dollar R&D program to correct electromagnetic interference and other deficiencies to make Pioneer minimally capable.[8] Six operational Pioneer systems flew over 300 combat missions during Desert Shield/ Desert Storm and conducted successful surveillance missions in Haiti, Somalia, and Bosnia.[9] Pioneer is "expected to remain in the Navy and Marine Corps inventory until about 2004..."[10] when its replacement system, which is currently in development, becomes operational.

Two other UAV systems were pursued by the Army, Navy and Air Force; however, both programs were canceled during development due to high costs and technical problems. According to the Government Accounting Office (GAO) the Medium Range UAV, a joint venture between the Navy and Air Force, was terminated in 1993 after it ran into "major difficulties" when the Air Force "payload ended up being too big to fit in the space the Navy had allotted inside the aircraft."[11] The second unsuccessful effort, the Army's Hunter UAV program, started in 1988 and was managed by a newly formed joint organization in Washington D.C..

Congress consolidated DOD's UAV acquisition efforts into a Navy-led UAV Joint Projects Office (JPO) and directed them to "manage and control UAV programs as joint efforts and prevent unnecessary duplication by the services."[12] Hunter was their first acquisition program. Although Hunter experienced reliability and other technical problems during development, the UAV JPO awarded a low rate production contract in 1993 for seven systems. Ultimately this contract was allowed to expire after acceptance testing identified new deficiencies with the software, data link, and engine; and several operational systems crashed.[13,14] These and many more of the United State's past and present UAV efforts are listed in Appendix F.

In 1994, the DOD created the Defense Airborne Reconnaissance Office (DARO) to provide oversight and guidance to all airborne reconnaissance efforts including UAVs.[15] DARO principally focused on developing and maintaining airborne reconnaissance architecture and therefore not only acted as the clearing house for UAV research and development funding, but also oversaw UAV activities in the Joint Project Office, Defense Advanced Research Projects Agency (DARPA), and the services.[16] Given the generally unsatisfactory results achieved in the past and our nation's increased expectations for UAVs in the future, DARO was looking for a new way to buy these weapon systems.

UAV ACTDs. Between 1994 and 1997, DARO either initiated or moved all of its UAV programs into the ACTD framework in the hopes of providing the warfighter UAV systems faster, cheaper, and better. UAV problems were no longer viewed as technology issues. General Fogleman, chief of staff of the United States Air Force, said, "We are now impressed by the convergence of technological advances in computers, flight controls, lightweight materials, advanced electric motors and communications packages that will make modern unmanned aerial vehicles extremely effective."[17]

The United States is currently procuring four major UAV systems using the ACTD process: Predator, Global Hawk, DarkStar, and Outrider. The first program, Predator Medium Altitude Endurance (MAE) UAV, was one of the first programs to emerge from the rapidly paced ACTD development program and transition to an Air Force production program.[18] Although Predator experienced some problems, OSD often highlights the system as the showpiece ACTD.[19] The High Altitude Endurance (HAE) UAV ACTD is developing two complementary UAVs, Global Hawk and DarkStar. DARPA manages this complex ACTD in close coordination with the Air Force.[20] The latest UAV program to enter the ACTD process was the Tactical UAV (TUAV) called Outrider. This high priority system is intended to replace the Pioneer UAV system currently fielded by the Navy and Marine Corps and provide the Army with their own tactical surveillance system.[21,22] Based on program cost estimates (see Appendix G), DOD would classify all these UAV systems as either ACAT I or ACAT II acquisition programs using the traditional DOD 5000 definitions. The three systems will now be described in greater detail to gain an understanding of their capabilities, achievements, and program issues.

Predator UAV

System Capabilities

The concept of operations (CONOPS) written by Air Combat Command describes the Predator as a medium altitude endurance UAV system designed to provide 24-hour, near-continuous, on-station surveillance with a 500 nautical mile (nm) operational radius using simultaneous electro-optical, infrared, and synthetic aperture radar sensors. The complex system consists of four air vehicles, one ground control station, and a communications suite.[23] Tactical commanders and intelligence experts are able to receive real-time video from the TV and Infrared (IR) sensors at a range of up to 150 nm by radio data link or they can view still-frame images (TV, IR, and Synthetic Aperture Radar (SAR)) from anywhere in the world through the Predator's satellite link.[24]

Development

Initially the Predator ACTD produced amazing results. The rapidly paced ACTD designed, developed, manufactured, and tested the medium altitude UAV in just 30 months.[25] The first air vehicle was delivered for testing six months after the initial contract award.[26] To meet the aggressive schedule and program cost objectives, engineers integrated off-the-shelf hardware (sensors, navigation equipment, and engine) and used basic aircraft design concepts to manufacture the prototypes. After fourteen months, the contractor delivered ten UAVs and three ground control stations to Predator's warfighting sponsor, U.S. Atlantic Command (USACOM), for evaluation.[27]

Deployment

The initial deployment identified operational issues. In 1995, after performing well in two stateside joint exercises (Roving Sands '95 and SOCOM's exercise in Key West, Florida), the JPO deployed Predator to Albania in support of Operation Deliberate Force.[28] Because the Air Force's operational forces were not organized or trained to support Predator, the JPO and their contractors initially operated and maintained the system.[29] In Bosnia, the system was "hampered by overcast skies and ground fog, forcing operators to fly…low..."[30] Of the three air vehicles sent, one was lost to hostile fire and one crashed due to engine problems.[31] Although the UAVs did provide valuable intelligence data, the JPO returned the remaining UAVs to the United States for subsystem upgrades after four months of operations.[32] The new improvements included adverse weather sensors (electro-optic (EO)/IR and SAR) as well as an ice detection capability.[33] Four months of wartime operations validated hardware reliability deficiencies, CONOPS issues, and system limitations needing further attention.

By March 1996, the JPO redeployed the upgraded Predator to support operations in Bosnia.[34] The system was greatly improved, but the warfighter again highlighted issues. For example, Predator's operations were very manpower intensive ("each Predator system requires approximately 653 personnel to support one orbit continuously."[35]) and the JPO had not developed a formal training program during the ACTD. Therefore, although the 11th Reconnaissance Squadron was activated in July 1995 it was not until October 1996 that they were able to assume full control of the weapon system.[36,37]

Predator's configuration constantly changed as the program office tested new capabilities and corrected problems. Again, "Predator deployments showed that the system [was] adversely affected by unfavorable weather conditions."[38] Combat experience reinforced the need for additional upgrades such as de-icing, UHF radio communications, IFF upgrades, and payload improvements…[39] The deployments illustrated how Predator's off the shelf hardware and the system requirements were initially inadequately defined to conduct its military mission and how the system evolved over time to meet the warfighter's expectations. While still conducting Bosnia operations, USACOM declared the military utility of Predator and advocated procurement of additional systems.[40]

Transition to Production

The Predator ACTD was widely criticized for its lack of production planning; the JPO had not adequately planned the transition to production. Fourteen months after the Predator ACTD officially ended the program formally entered the acquisition process and transitioned to low-rate initial production.[41] Major General Kenneth Israel, the director of DARO, attributed the delay to an unfulfilled requirement to procure adequate support equipment while others cited the "slow pace of the Air Force Air Combat Command's preparation of an operational requirement…"[42]

Entering the production phase of the traditional acquisition process required Defense Acquisition Board (DAB) approval, and therefore, the Predator program had to meet a minimum number of prerequisites from DODR 5000.2-R. For example, the user had to have operational requirements approved by the Joint Requirements Oversight Council (JROC) and the operational test community had to evaluate operational effectiveness and suitability as required by law.[43,44] This was difficult for the operational testers to do since they were not originally included in the ACTD testing and the JROC did not approve the Operational Requirements Document (ORD) until 13 months after completion of the

ACTD.[45] In addition, the test configuration kept changing with each new or updated hardware/software upgrade so the production configuration remained different from that tested in the ACTD.

Because the streamlined ACTD process omitted many basic acquisition activities, it was difficult and time consuming to work through the prerequisite activities required for the traditional Milestone III production approval. In the end, the Under Secretary of Defense for Acquisition and Technology approved entry into production and delegated future milestone authority to the Air Force Acquisition Executive.[46] This approval marked the first time any ACTD transitioned to the formal acquisition system and showed the other UAV ACTDs it was possible to reach this critical milestone.

High Altitude Endurance Unmanned Aerial Vehicle

There are two complementary HAE UAV systems in development, the conventional Global Hawk and the stealthy DarkStar. These two systems are fully autonomous, high altitude, long endurance UAVs designed to provide near real time reconnaissance, surveillance, and target acquisition (RSTA) information to operational commanders.[47] In addition to sharing very similar missions, DARPA's HAE UAV program office is developing both weapon systems using the ACTD process.[48]

Before DarkStar became an ACTD in 1995, Lockheed Martin Skunk Works was building two prototype systems in a covert special access program.[49] The DOD chose to pull the stealthy UAV out of the black world so it could openly compete with the Global Hawk for the HAE UAV mission. Ultimately, DARPA carried both efforts forward in the ACTD process as a lower risk method of meeting the military need.

System Capabilities

The HAE UAVs are more complex than Predator or any other previous UAVs; therefore, they carried a significantly greater technical risk. Engineers optimized the stealthy DarkStar design for protection in a high threat environment while the other contractor team designed the much larger Global Hawk to operate in a low to moderate threat environment. As a result of the airframe design differences, DarkStar's loiter time and payload capacity are much less than Global Hawk's.[50] Specific HAE UAV performance characteristics are included in Appendix D.

Development

The duration of an ACTD typically varies from a few months to four years.[51] However, with few exceptions, the original HAE UAV ACTD program schedule shown in Figure 1 looks very similar to a three-phased, five year, traditional acquisition program with the names changed for the Concept Exploration (CE), PDRR, and Engineering, Manufacturing and Development (EMD) phases.

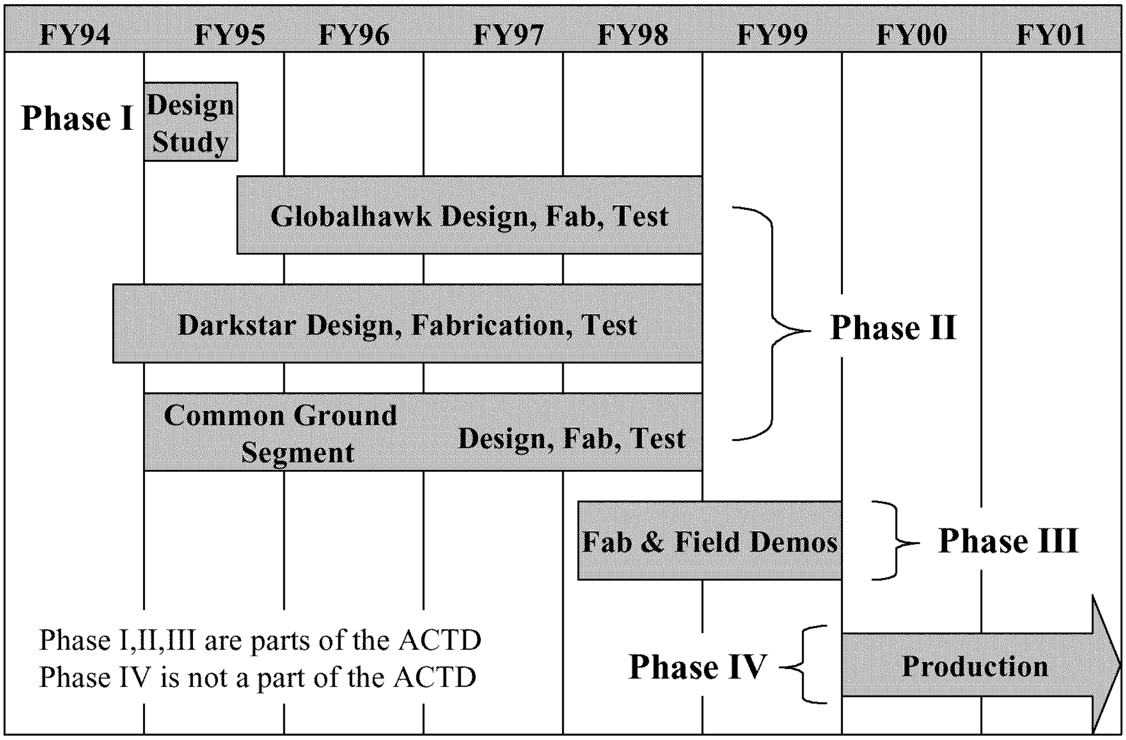


Figure 1. HAE UAV Development Schedule[52]

DARPA's chief of endurance UAV programs characterized the schedule as "...very, very aggressive..."[53] The ACTD's competitive six month Phase I design study period allowed five contractors to develop initial HAE UAV design concepts. Phase II development and flight tests downselected to one of the five contractors and brought the DarkStar program into the ACTD process.[54] Just like a major acquisition's PDRR phase, the purpose of this ACTD phase was to perform the detailed design, manufacture prototypes, and conduct contractor development testing. Software problems during Phase II delayed DarkStar's first flight six months and the caused a fiery crash on its second flight.[55,56] The April 1996 crash drove hardware and software redesigns, caused a minimum one-year schedule delay, and increased DarkStar development costs by at least $22 million.[57] Global Hawk's first flight was also scheduled for 1996, but the program experienced technical problems, and management wanted to make sure there would not be a repeat crash; first flight was delayed more than a year.[58,59,60]

During DarkStar's Phase III, which is very similar to a traditional EMD, the contractors will fabricate at least three (and potentially 8) additional air vehicles and two ground control stations to support a fifteen-month system level field demonstration.[61] When RAND interviewed the contractors they found "there was particular concern expressed about the overlap between Phase II flight testing and the ordering of Phase III long-lead items, along with the expressed intent of DUSD/AT to avoid any development in Phase III."[62] Contractors were "concerned about the possibility of a schedule disruption due to high concurrency of development and 'production.'"[63] RAND suggested the aggressive ACTD schedule "…will tend to drive (and hopefully, limit) program nonrecurring engineering (NRE) costs."[64] However, as was the case in the Predator program, this concurrency will likely breakup the warfighter's field demonstrations and introduce multiple test configurations as the weapon systems are upgraded to correct deficiencies identified in the contractor's Phase II testing.

Based on the delays to date, the 1997 DARO report forecasted a 1-year production slip to FY2001 for both HAE systems.[65] Therefore, the two to four year rapid prototyping and field demonstration originally characteristic of the ACTD process now looks even more like a multi-phased six year traditional acquisition program.

Program Management

Both HAE UAV weapon systems are currently under development by DARPA in a Joint Program Office with the Department of the Air Force, Navy, and Army.[66] DARPA manages the Phase I and II HAE UAV program for DARO and will transfer ACTD management responsibility to an Air Force System Program Office for Phase III and any follow-on (R&D or production) effort.[67] The program's management structure depicted in Figure 2 illustrates the high level of management oversight this program receives.

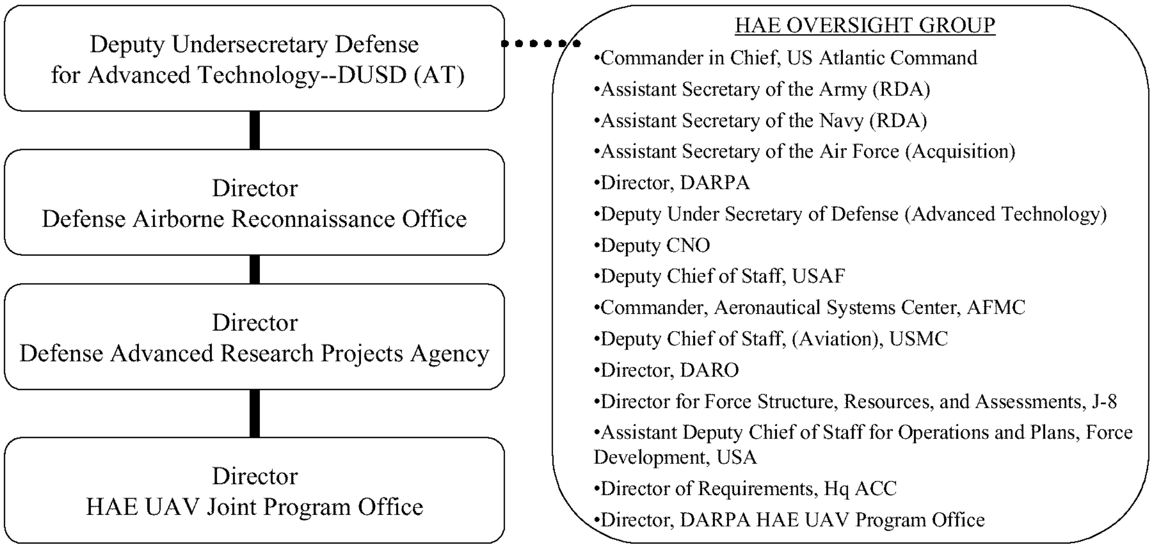


Figure 2. HAE UAV Program Oversight[68]

HAE UAV program officials organized the contractors, warfighters, and government acquisition organizations into working level Integrated Process Teams (IPTs) just like major defense acquisition programs today. However, because this was an ACTD program, the warfighter representatives from USACOM played a much more decisive role in the IPTs. They planned the demonstrations, identified assessment criteria, maintained cognizance over the contractor's logistics support system, and will ultimately judge the UAV's military utility by identifying system capabilities and limitations during the Phase III demonstrations.[69] In addition, at the conclusion of the ACTD, they will provide an ACTD CONOPS for joint employment and a force mix recommendation to the JROC.[70]

Cost Goal

Perhaps the most significant design driver on the program was the $10 million unit flyaway price target for each air vehicle and sensor package. Mr. Charles E. Heber, the DARPA program director said cost was the "single requirement."[71] Having this Cost as an Independent Variable (CAIV) objective means the government was willing to trade operational performance to meet the production unit price target. In order to provide the greatest performance at this price, the contractors and DARPA emphasized the use of commercial-off-the shelf (COTS) components and low-risk technical approaches.[72] The contractors also substituted commercial manufacturing technologies and specifications for military standards and regulations.[73] These program management techniques (CAIV, IPTs, Commercial practices, COTS, etc.) were the same initiatives described in the new DOD 5000 series regulations for major acquisition programs.

Contracting

Until 1997, the most unique aspect of the HAE UAV program was its contracting mechanism. According to the program's management plan, they were conducting an "acquisition experiment" using Other Transaction Authority (OTA), also known as Section 845 Agreement Authority.

> It is a broad and flexible authority, granted within the constraints of public law, which allows DARPA to enter into contractual agreements without the normal statutory and regulatory requirements of the procurement system. The OTA permits DARPA to field and conduct technology demonstrations of military systems authorized under Section 845 of the National Defense Authorization Act (Public Law 103-160, enacted November 1993).[74]

DARPA's HAE UAV program was the first program to use Section 845 authority,[75] but the 1997 congressional authorization act expanded (on a trial basis) the prototyping authority to the entire DOD.[76] It will not be long before many programs are using this flexible contracting approach.

Outrider UAV

Background

Outrider is a tactical UAV (TUAV) for the Army, Navy, and Marine Corps that combines requirements from two previously failed UAV development efforts, the Aquila and the Hunter UAVs.[77] The JROC rated this tactical drone its top UAV priority.[78] At the time of program initiation, John W. Douglass, Assistant Navy Secretary for Research, Development, and Acquisition, believed the Outrider would be a success because of the efforts made to "harmonize the requirements of each military service."[79] It is designed to conduct reconnaissance and surveillance missions at ranges beyond 200 kilometers and have an on station loiter time of more than four hours.[80] "Outrider is designed to operate from aircraft carriers, large-deck amphibious ships, and unprepared airfields ashore."[81] The $52 million, two year long ACTD to design, build and test 24 TUAVs began in 1996 and if successful will transition to low-rate initial production (LRIP) in 1998.[82,83]

Development

Like the HAE UAV program, the JROC and Dr. Kaminski established a specific CAIV objective of $350,000 for the thirty-third air vehicle and sensor package.[84] As the contractors designed the systems, the government encouraged them to trade-off performance requirements to this achieve cost goal.[85] Initially the prime contractor thought the effort would be a straightforward integration of new COTS technology since they had already built and flown a prototype.[86] However, soon after contract award, DOD directed development and integration of a new heavy fuel engine and an automatic landing capability.[87] "The vehicle [flew] on gasoline, but the Naval Services [wanted] the Outrider to be fitted with a heavy-fuel engine that could use the jet fuel available on carriers."[88] Requirements growth, like this, often make program execution more difficult and increase program costs. During the first year of the ACTD the "price tag for the effort ballooned."[89]

By first flight, the Outrider was almost fifty percent over its design weight of three hundred pounds.[90] This reduced the operating range and loiter time to an unacceptable level. The Undersecretary of Defense for Acquisition and Technology intervened and, together with the director of DARO, the UAV JPO Program Executive Officer, and the program manager, reviewed the program's "slow progress on its ACTD effort." He gave the UAV's prime contractor 60 days to show progress at which time he would consider terminating the program.[91] Consequently, the contractor redesigned the aircraft's wings and conducted additional analysis to demonstrate an acceptable level of performance.[92] Dr. Kaminski allowed the ACTD program to continue, but systems engineering problems permanently slowed development and increased the cost of the program.[93]

Schedule Issues

The DOD limited the Outrider ACTD to a "very ambitious" [94] two-year schedule. Therefore, the development problems reduced the length and scope of the planned Army and Marine Corps military utility assessments.[95] ACTD program managers shortened the Fort Hood assessment from six to four months and eliminated Marine Corps testing at Fort Irwin, CA, and Navy ship board testing.[96] Marine Corps Major General Hanlon said, "I'm not sure we get a good maritime evaluation at Ft. Hood."[97] Just three months before the testing was scheduled to start, the program office said the forecasted date was challenging because Outrider was not integrated with its ground station and there was insufficient time to adequately train the troops who would operate the UAV at Ft. Hood.[98]

During a recent review for the Honorable William S. Cohen, Secretary of Defense, the GAO concluded Outrider demonstrations would be inadequate to justify future production. The GAO was concerned that the DOD will exercise the ACTD's LRIP option without "conducting realistic operational testing."[99] This option allows procurement of six additional systems, two maintenance facilities, and eight replacement or attrition air vehicles.[100] Based on lessons learned from previous nondevelopmental UAV programs (specifically Pioneer and Hunter), the GAO believed "these user demonstrations…will not provide the same level of assurance for justifying a low-rate production commitment as would operational testing…"[101] Outrider's integration, training, test, and production issues are strikingly similar to the ones present in Predator, Global Hawk, and DarkStar.

UAV Summary and Conclusions

Between 1994 and 1998 Congress was "very supportive of DOD's UAV programs" and showed their approval by increasing funding beyond the Pentagon's request for Pioneer, Predator, DarkStar, and other UAV efforts.[102] However, in the fiscal year (FY) 1998 budget deliberations, congressional committees perceived a lack of adequate progress by the Pentagon in transitioning ACTD UAV programs into production and operational use.[103] The Senate Appropriations Committee said it was "discouraged with results of the remaining three UAV ACTD programs and believes it is time to review DOD's entire UAV strategy."[104]

The UAV case studies presented in this chapter highlighted just a few of the issues slowing UAV development and fielding, and support congressional concern about our UAV development efforts. The common issues include frequent configuration changes, joint program requirements development, concurrent development and test schedules, inadequate training and maintenance planning, reliability problems, software development issues, production planning shortfalls, flight mishaps, off-the shelf hardware integration difficulties, and affordability concerns. These problems are certainly not unique to UAV developments or the ACTD process itself. DOD acquisition organizations encounter many of these same problems on development programs managed within the DOD 5000 series framework. So, while the ACTD process is constantly evolving to include lessons learned from previous efforts, it is borrowing traditional logistics, configuration control, test, program control, software and systems engineering techniques from the mainstream acquisition system. DOD is recognizing that the added rigor and increased functional emphasis present in the mainstream acquisition is necessary to minimize risks commonly found in major weapon system development programs.

The next chapter will summarize the research findings and draw conclusions applicable to future UAV development efforts, the ACTD process, and the much larger DOD procurement system.

Notes

[1] Geoffrey Sommer et al., *The Global Hawk Unmanned Aerial Vehicle Acquisition Process*, RAND Report 19970221 (Santa Monica, Calif.: RAND, February 1997), 10-11.

[2] Michael Armitage, *Unmanned Aircraft*, (Washington: Brassey's Defence Publishers, 1988), 85.

[3] Steven J. Zaloga, "UAVs Gaining Credibility," *Aviation Week and Space Technology*, 12 January 1998, 93.

Notes

[4] Gen Charles C. Krulak, Commandant of the United States Marine Corps, "Riding the Dragon into the 21st Century, Innovation and UAVs in the United States Marine Corps," *Unmanned Systems*, summer 1996, 11.

[5] Louis J. Rodriques, Director, Defense Acquisitions Issues, United States General Accounting Office, "Unmanned Aerial Vehicles, DOD's Acquisition Efforts," GAO Report GAO/T-NSIAD-97-138 (Testimony Before the Subcommittees on Military Research and Development and Military Procurement, Committee on National Security, House of Representatives, 9 April 1997), 2.

[6] ibid, 2.

[7] Krulak, 11.

[8] Rodriques, 2

[9] Rear Admiral Barton D. Strong, Prepared Statement before the Senate Armed Services Committee, Subcommittee on Airland Forces, Washington D.C., 29 March 1996, n.p., http://web.lexis-nexis.com/congcomp.

[10] Glenn W Goodman, "Relying on Drones: Predator Shows the Way for Three Other New Military UAVs," *Armed Forces Journal International,* May 1997, 30.

[11] Rodriques, 3.

[12] ibid, 1.

[13] ibid, 4.

[14] Steven J. Zaloga, "UAV Military Future Deemed Promising," *Aviation Week and Space Technology*, 13 January 1997, 89.

[15] Strong, n.p..

[16] ibid, n.p..

[17] Doug Richardson, "Unmanned Aerial Vehicles Stretch their Wings," *Armada International*, October-November 1996, 6.

[18] Kaminski, Statement before the Acquisition and Technology Subcommittee, n.p..

[19] Kaminski, Statement before the Acquisition and Technology Subcommittee, n.p..

[20] Defense Airborne Reconnaissance Office, "UAV Annual Report, FY1996" (Washington, D.C.: Defense Airborne Reconnaissance Office, 6 November 1996), 20-23. on-line, Internet, 10 December 1997, available from http://www.acq.osd.mil/daro/homepage/uav96/content.html.

[21] Goodman, 30.

[22] Jason Sherman, "Flight of the Outrider: The Pentagon's Top-Priority UAV Program Pushes Forward after a Rocky Start," *Armed Forces Journal International,* May 1997, 28.

[23] "Air Combat Command Concept of Operations for Endurance Unmanned Aerial Vehicles," (HQ ACC/DO document, 3 December 1996), 10; on-line, Internet, 5 December 1997, available from www.acc.af.mil/do/dou/conops.htm.

[24] Goodman, 32.

[25] Rodriques, 11.

[26] Strong, n.p..

[27] "Medium Altitude Endurance UAV, Predator," (Deputy Undersecretary of Defense for Advanced Technology web site document, n.d.), n.p.; on-line, Internet, 5 December 1997, available from http://www.acq.osd.mil/at/mae.htm.

Notes

[28] "Predator Unmanned Aerial Vehicle, Operations," (Joint Program Office Website, n.d.), n.p.; on-line, Internet, 5 December 1997, available from http://www.peocu.js.mil/Predator/INDEX.HTML.

[29] David A. Fulghum, "Unmanned 'Spies' to tune in Bosnia*," Aviation Week and Space Technology*, 29 April 1996, 58.

[30] Frank Olivieri, "Who Will Control Spy Planes?" *Air Force Times,* 28 August 1995, 23.

[31] Rodriques, 5.

[32] "Predator Unmanned Aerial Vehicle, Operations," n.p..

[33] "Medium Altitude Endurance UAV, Predator," n.p..

[34] Strong, n.p..

[35] "Air Combat Command Concept of Operations for Endurance Unmanned Aerial Vehicles," 11.

[36] Goodman, 30.

[37] Rodriques, 5.

[38] Rodriques, 5.

[39] Defense Airborne Reconnaissance Office, "UAV Annual Report, FY1996," 13.

[40] "Medium Altitude Endurance UAV, Predator," n.p..

[41] ibid, n.p..

[42] Gerald Green, "Predator UAV Continues Bosnian Surveillance," *Journal of Electronic Defense*, July 1997, 14.

[43] DOD Directive 5000.1, 11.

[44] DOD Regulation 5000.2-R, part 3, 2,18.

[45] Jerry Green, "Predator Approved for Production," *Unmanned Systems*, summer 1997, 32.

[46] "Medium Altitude Endurance UAV, Predator," n.p..

[47] "Draft Initial Requirements Document, CAF 003-90-I-B, for the High Altitude Endurance Unmanned Aerial Vehicle/System (HAE UAV)," (HQ ACC/DRR-SMO-U document, n.d.), 14.

[48] "High Altitude Endurance Unmanned Aerial Vehicle Program (HAE UAV) Advanced Concept Technology Demonstration Management Plan," (HAE UAV Program Office document, 27 June 1997), 18.

[49] Vincent P. Grimes, "Drone Aircraft Builders Expect Market Growth," *National Defense,* November 1996, 38.

[50] "Air Combat Command Concept of Operations for Endurance Unmanned Aerial Vehicles," 10.

[51] "Guidelines for ACTD Management Plans," n.p..

[52] High Altitude Endurance Unmanned Aerial Vehicle Program (HAE UAV) Advanced Concept Technology Demonstration Management Plan," 4.

[53] David A. Fulghum, "Global Hawk UAV May Fly Early," *Aviation Week and Space Technology*, 29 April 1996, 25.

[54] "High Altitude Endurance Unmanned Aerial Vehicle Program (HAE UAV) Advanced Concept Technology Demonstration Management Plan," 5-8.

Notes

[55] Doug Richardson, "Unmanned Aerial Vehicles Stretch their Wings," *Armada International,* October-November 1996, 8.

[56] Rodriques, 13.

[57] Defense Airborne Reconnaissance Office, "UAV Annual Report, FY1996," 2.

[58] Grimes, 39.

[59] Rodriques, 12.

[60] "Global Hawk Completes First Flight," Air Force News Service, 2 March 1998, n.p.; on-line, Internet, 5 March 1998, available from HTTP:/www.af.mil/news/Mar 1998/n19980302_980276.html.

[61] Sommer, 23.

[62] ibid, 23.

[63] ibid 24.

[64] ibid, 2.

[65] Defense Airborne Reconnaissance Office, "UAV Annual Report, FY 1997," (Washington, D.C.: Defense Airborne Reconnaissance Office, 6 November 1997), 33-34. on-line, Internet, 1 March 1998, available from http://www.acq.osd.mil/daro/uav97/ toc.html.

[66] Charles E. Heber, Director, High Altitude Endurance Unmanned Air Vehicle (HAE UAV) Program Office, Defense Advanced Research Projects Agency (DARPA), "Prepared Statement before the Senate Armed Services Committee, Subcommittee on Airland Forces," March 29, 1996, n.p.; on-line, Internet, 1 March 1998, available from http://web.lexis-nexis.com/congcomp/document.

[67] "High Altitude Endurance Unmanned Aerial Vehicle Program (HAE UAV) Advanced Concept Technology Demonstration Management Plan," 16.

[68] Sommer, 10-13 Appendix G.

[69] ibid, 19-20.

[70] ibid, 19-20.

[71] Heber, n.p.

[72] Sommer, 33.

[73] "High Altitude Endurance UAV," (Deputy Undersecretary of Defense for Advanced Technology Web site document, n.d.), n.p.; on-line, Internet, 10 December 1997, available from http://www.acq.osd.mil/at/hae.htm.

[74] "High Altitude Endurance Unmanned Aerial Vehicle Program (HAE UAV) Advanced Concept Technology Demonstration Management Plan," 1.

[75] Sommer, 15.

[76] Kaminski, Statement before the Acquisition and Technology Subcommittee, n.p..

[77] Grimes, 38.

[78] Sherman, 28.

[79] Grimes, 38.

[80] Rodriques, 10.

[81] Grimes, 38.

[82] Rodriques, 10.

[83] Sherman, 28.

[84] Grimes, 38.

Notes

[85] Strong, n.p..

[86] David A. Fulghum, "Outrider UAV Tackles Army, Navy Requirements," *Aviation Week and Space Technology*, 22 July 1996, 70.

[87] Gerald Green, "Outrider Tactical UAV First Flight Scheduled for November," *Unmanned Systems,* summer 1996, 42.

[88] "Tactical UAV Given New Life," *Marine Corps Gazette,* 4 July 1997, 4.

[89] Sherman, 28.

[90] Sherman, 29.

[91] Gerald Green, "Unmanned Systems Gain Support in Military, Congress," *Unmanned Systems,* winter 1996-1997, 35.

[92] "Tactical UAV Given New Life," 4.

[93] Sherman, 29.

[94] Green, "Outrider Tactical UAV First Flight," 41.

[95] "Unmanned Aerial Vehicles: Outrider Demonstrations Will Be Inadequate to Justify Further Production," Government Accounting Office Report NSIAD-97-153 (Washington D.C.: Government Printing Office, 23 September 1997), 5.

[96] George Cahlink, "Concerns Raised Over Reduced Time, Scope for Outrider ACTD Assessment," *Inside the Army,* 19 January 1998, 6.

[97] "Navy VTOL UAV Decision Likely This Summer," *Aerospace Daily*, 20 January 1998, 87.

[98] "Army will conduct "Make or Break" Testing of Outrider in March," *C4I News*, 15 January 1998, 8.

[99] "Unmanned Aerial Vehicles: Outrider Demonstrations," 3.

[100] Grimes, 38.

[101] "Unmanned Aerial Vehicles: Outrider Demonstrations," 3.

[102] "UAV Programs Gain Congressional Support as Major Milestones Loom," *Journal of Electronic Defense*, February 1997, 16.

[103] Jerry Green, "House NSC Recommends Abolishing DARO and Shifting Recon to DIA," *Unmanned Systems*, summer 1997, 31.

[104] Jerry Green, "One-Year Moratorium on New-Start UAV Program Declared by Senate Appropriations Committee," *Unmanned Systems*, summer 1997, 31.

Chapter 5

Summary and Conclusions

> *Initially, the Department of Defense created this ACTD approach to "jump start" our slow acquisition system. Now, I see strong evidence that the Services have embraced and are using OSD-developed principles to speed up and improve the responsiveness of their own acquisition systems.*
>
> —Honorable Paul G. Kaminski, DUSD(A&T)

The Packard Commission recommended DOD move new technology to the warfighter faster by conducting early operational testing with prototype systems. The DOD developed the ACTD program to meet this challenge, and for several years, the process was a streamlining success story. Now that DOD reformed the mainstream system to reduce its bureaucracy and provide program managers more flexibility, the ACTD process should not be used to develop and test complex major weapon systems like UAVs.

This research demonstrated that major themes of the ACTD process are included in the current DOD 5000 system. Although the defense acquisition programs traditionally do not place the same emphasis on rapid technology transition, early field demonstrations, warfighter involvement, and residual capabilities, the new DOD 5000 system does not restrict a program manager from incorporating these tenants into his or her program. In the future, major weapon system program managers should heed the advice of the Packard commission and make every attempt to emphasize ACTD themes in their acquisition strategies.

Process differences between the two programs have all but been eliminated due to the convergence of the two systems over time. Both systems develop prototypes to reduce risk and refine system performance characteristics; both systems define critical operational performance requirements early as possible and try to keep other parameters available for cost trade-offs; both systems must use the PPBS system obtain funding; both systems have senior level oversight groups to review and approve program progress. While DSMC identified these areas as differences between PDRR prototyping and the ACTD process, the differences are superficial.

The case studies showed that in the rush to build ACTD demonstrators and get them in the hands of the warfighting sponsors for evaluation, the government and their contractors omitted critical steps. Predator didn't operate well in Bosnia's poor weather and required numerous system upgrades. The fully autonomous HAE UAVs experienced software and integration problems as well as a serious crash that hampered its already extended ACTD development program. The Outrider system required a major wing redesign while OSD forced the program to drastically cut the scope of its field-testing to stay within its tight two year ACTD schedule. No one can say with absolute certainty that the DOD 5000 governed system would have prevented these problems from occurring, but clearly the mainstream acquisition system does place more emphasis on methodically working through a broader range of widely accepted risk mitigation techniques.

If the Predator, Global Hawk, Darkstar, and Outrider UAVs were developed in the new DOD 5000 acquisition environment, they could have designed, integrated, manufactured, and field tested prototype systems early in the PDRR phase knowing the added rigor established in the DOD 5000 series would help minimize program risks. In the long run, the mainstream acquisition process has a greater potential to reduce life cycle costs and provide the warfighter a weapon system that meets his operational needs.

As a result of this research, three recommendations emerged. First, the research supported the thesis that DOD should not initiate major acquisition programs in the ACTD process. If the department chooses to continue developing major weapon systems using the ACTD process, the program will continue to lose its uniqueness and become overburdened as it incorporates additional successful mainstream acquisition practices. Secondly, OSD should strengthen the mainstream acquisition system's ties to the warfighting CINCs. The ACTD process does an excellent job linking the acquisition community with the real warfighting users—the CINCs. Currently the JROC provides an interface, but defense acquisition programs would benefit greatly if they worked more closely with a warfighting sponsor to develop and test new weapon systems. Finally, future research should consider whether the ACTD process provides non-major acquisition programs or software-intensive programs a viable acquisition strategy. It is not obvious from this research effort whether the ACTD process offers a viable acquisition strategy for any other types of procurement efforts.

Appendix A

ACTDs Approved in FY1995, FY1996, FY1997, FY1998

FY 1995	FY 1996	FY 1997	FY 1998
Advanced Joint Planning	Air Base/Port Biological Detection	Chemical Enhancement to Bio Detection	Joint Biological Remote Early Warning System
Boost Phase Intercept	Battlefield Awareness and Data Dissemination	Consequence Management	Info Assurance, Automated Intrusion Detection Environ.
Cruise Missile Defense	Combat Identification	Counter-proliferation II	Joint Continuous Strike Environment
High Altitude Endurance UAV	Combat Vehicle Survivability	Extending the Littoral Battlespace	Joint Modular Lighterage System
Joint Countermine	Counter-proliferation	Information Warfare Planning tool	Precision Target Identification
Low Life Cycle Cost Med Lift Helicopter	Countersniper	Integrated Collection Management	Unattended Ground Sensors
Medium Altitude Endurance UAV	Joint Logistics	Joint Helicopter Health and Usage Monitoring System	Theater Precision Strike Operations
Precision / Rapid Counter MRL	Joint Readiness Extension to AJP	Military Operations in Urban Terrain	Line-of-Site Anti-Tank System
Precision SIGINT Targeting System	Miniature Air-Launched Decoy	Rapid Terrain Visualization	
Rapid Force Projection Initiative	Navigation Warfare	Wide Area Tracking System	
Synthetic Theater of War	Semi-Automated IMINT Processing		
	Tactical High Energy Laser		
	Tactical UAV		

Source: "ACTD Descriptions," (Deputy Undersecretary of Defense for Advanced Technology web site document, n.d.), n.p., Online, Internet, 10 December 1997, available from http://www.acq.osd.mil/at/descript.htm.
"FY98 Advanced Concept Technology Demonstrations Announced," 21 November 1997, n.p. Online, Internet, 10 December 1997, available from www.dtic.mil/ defenselink.

Appendix B

Acquisition Program/ACTD Differences

	Acquisition Program	Advanced Concept Technology Demonstration (ACTD)
Motivation	Develop, produce, and field system Cost, Schedule, performance	Gain understanding of and evaluate utility prior to acquisition decision Develop concepts of operation and doctrine
Requirement	MNS/ORD	Not required
Oversight	Milestone decision authority	DUSD(AT) Oversight Panel
Funding	Fully FYDP funded	RDT&E (+2years in field)
ACAT	All ACATs	Not ACAT effort
Configuration & Testing	System/subsystem Prototypes DT/OT	Tech demonstrations in field environment with users
Rules	DOD 5000 series/FAR	ACTD Mgmt Plan / FAR
Role of User	Max involvement	Max involvement

Source: Jim Sheldon, "Role of Science and Technology Activities," (Defense Systems Management College, Acquisition Policy Department Teaching Note, Acquisition Policy Advanced Program Management Course (APMC) 97-1, 1 December 1996), 72.

Appendix C

Advanced Technology Breakfast Club (AT/BC) Membership

Deputy Under Secretary of Defense (Advanced Technology) [Chair]
Director, Defense Research & Engineering
Deputy Asst. Sec. of Defense for Command, Control, Communications & Intelligence
Service Science & Technology executives (Gen/Flag/SES)
Director, Ballistic Missile Defense Organization (LTG)
Director, Defense Advanced Research Projects Agency (SES)
Army, Navy, Marine Corps & Air Force HQ Ops Staff Representative (Gen/Flag)
Joint Staff (J-8) representative (Gen/Flag)

Source: Jim Sheldon, "Role of Science and Technology Activities," (Defense Systems Management College, Acquisition Policy Department Teaching Note, Acquisition Policy Advanced Program Management Course (APMC) 97-1, 1 December 1996), 70.

Appendix D

HAE UAV Management Plan Performance Objectives

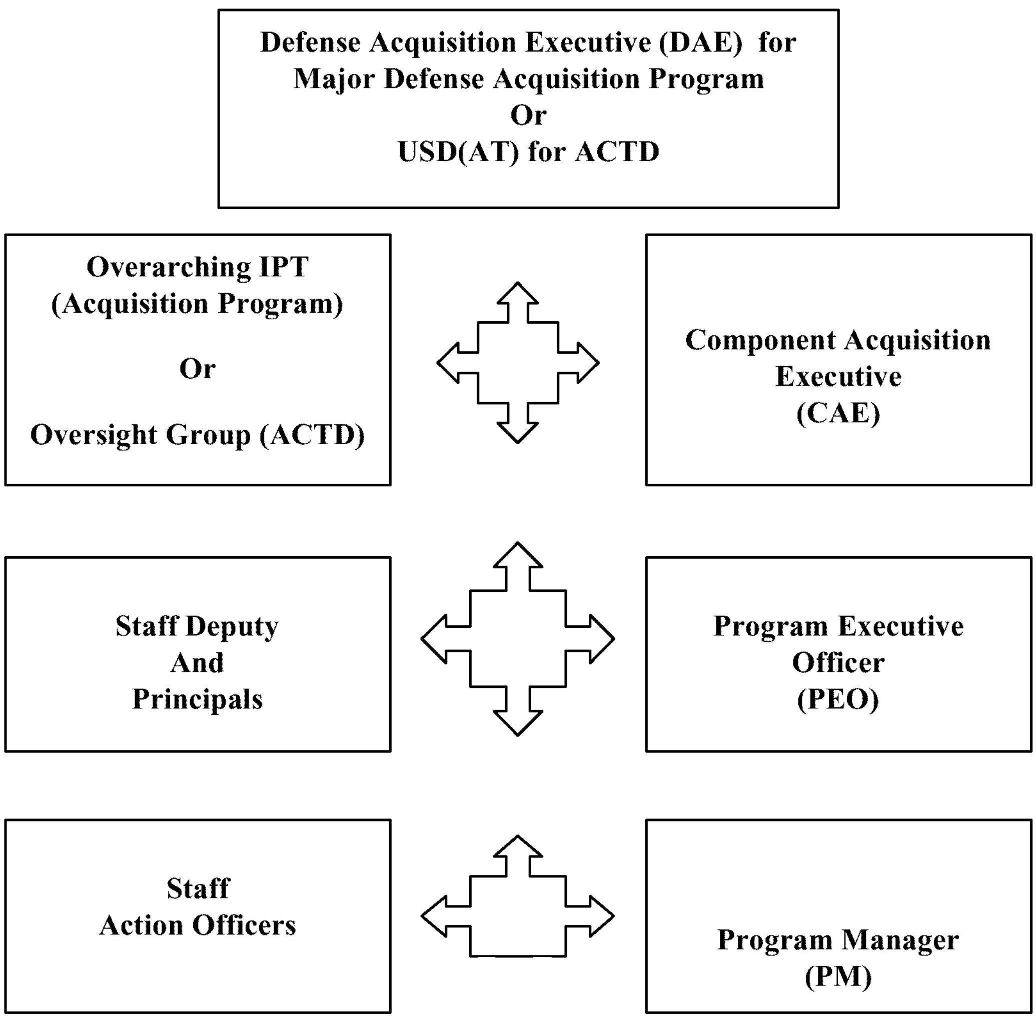
CHARACTERISTICS	GLOBAL HAWK	DARKSTAR
Mission On-Station Loiter	24 hrs	>8* hrs
Operating Radius (nm)	3,000	>500*
Loiter Altitude (ft msl)	>60,000	>45,000*
True Air Speed (knots)	300-350	>250*
Gross Takeoff Weight (lbs)	25,600	8,600
Survivability Measures	Threat Warning, ECM & Decoys	Very Low Observable
Sensor Payload	SAR, GMTI & EO/IR	SAR or EO
Sensor Payload Wt (approx)	1,8000lbs	1000lbs
Sensor Characteristics EO/IR (@45^{o} from Nadir (NIIRS Rating) Wide Area Search Mode Spot Collection Mode Synthetic Aperture Radar (Impulse Response) Wide Area Search Mode Spot Collection Mode Geolocation Accuracy GMTI Mode	EO/IR: 6.0/5.0 EO/IR: 6.5/5.5 1 Meter 0.3 Meter 20 Meter CEP 90^{o} in 120 sec 4KT MDV	EO: 5.0 EO: 5.0 1 Meter 0.3 Meter 20 Meter CEP N/A
Sensor Data Transmission (Mbps)	Wide Band COMSAT: 1.5-50 LOS Wide Band CDL:1.5-274	Narrow Band COMSAT: 1.5 LOS Wide Band CDL 137
Command and Control	UHF Fleet SATCOM, Ku Band COMSAT, X Band LOS CDL	
Ground Segment	Common	
Data Exploitation	CIGSS compliant (e.g., JSIPS/JSIPS-N, JSPS-TEG, CARS, ETRAC/TES, MIES), JICS, NPIC, and TCS)	
Transport**(Grd & Spt Segt)	3 C-141s or 2 C-17s	

* The precise number is classified **Additional transportation required to airlift DarkStar air Vehicle(s)

Source: "High Altitude Endurance Unmanned Aerial Vehicle Program (HAE UAV) Advanced Concept Technology Demonstration Management Plan," 2.

Appendix E

Traditional Acquisition / ACTD Oversight and Decision Making Process



Source: Adapted from Department of Defense, "Rules of the Road: A guide for Leading Successful Integrated Product Teams," (USD(A&T) document, November 1995), n.p..

Appendix F

U.S. UAV Programs

Designator	Name	Date	Role	Comment
BQM-34	Firebee	Early50s	Drone	Test platform
	RPH	Mid 50s	Helicopter Assault	USMC-Canceled
AQM-34	Firebee	Mid 60s	Recon/Surv	wide use – 24 versions
D-21		Mid 60s	Sup Son Recon	Only payload recovered
	Bikini	Late 60s	Recon	USMC – Canceled
AQM-91a	Compass Arrow	Late 60s	Recon/Surv	USAF RPV-Canceled
QH-50	DASH	Early70s	Recon/targeting	Navy/Marine - Canceled
BGM-34		Mid 70s	Combat Drone	Development only
YQM-94A	B-Gull	Mid 70s	HAE	Canceled
YQM-98A	Compass Cope	Mid 70s	HAE	Canceled
	Aquila	Early80s	RSTA	Army-canceled
CL-227	Sentinel	Early80s	Multipurpose	Navy VTOL RPV
	Mastiff	Mid 80s	Recon/target	Israeli NDI- USMC ops
	Pioneer	Mid 80s	Surv/Intel	Army, Navy, Marines Ops
BQM-147a	Exdrone	Late 80s	Recon	Navy/Marines Ops
FM-151A	Pointer	Late 80s	RSTA	Nat Guard, USMC, Army
R4E-50	SkyEye	Late 80s	Multi-mission	US Operations
	Gnat750	Late 80s	RSTA	CIA Operation
	Eagle Eye	Early90s	STA	VTOL Program suspended
	Predator	Early90s	RSTA	USAF Production/Operation
BQM-145a	Med. Range	Early90s	RSTA	Navy / AF – Canceled
	Huntair	Early90s	Surv/Attack	No details
BQM-155	Hunter	Early90s	RSTA	Army – Canceled
	Global Hawk	Late 90s	HAE	AF Development
	DarkStar	Late 90s	HAE	AF Development
	Outrider	Late 90s	Multipurpose	AR, Navy, USMC Develop

Sources: "Unmanned Aerial Vehicles and Drones," *Aviation Week and Space Technology*, 12 January 1998, 96-103.
P. Worch, *Report on UAV Technologies and Combat Operations*, Appendix 1, 23-25.
Rodriques, "Unmanned Aerial Vehicles, DOD's Acquisition Efforts," 1-6.

Appendix G

UAV ACTD Cost and Quantity Information

UAV	Minimum number of UAV purchased during ACTD	R&D Cost ($, M)	Production Qty	Production Cost ($, M)	Projected ACAT category*
Predator	10	210	52	369	II
Global Hawk	8	643	TBD	TBD	I
Dark Star	6	326	TBD	TBD	II
Outrider	24	268	240	583	II

Source: Louis J. Rodriques, Director, Defense Acquisitions Issues, United States General Accounting Office, "Unmanned Aerial Vehicles, DOD's Acquisition Efforts," GAO Report GAO/T-NSIAD-97-138 (Testimony Before the Subcommittees on Military Research and Development and Military Procurement, Committee on National Security, House of Representatives, 9 April 1997), 10-13.

*Based on the definitions provided in DODR 5000.2R and on the program cost information, the ACTDs would be categorized as ACAT Level I and Level II acquisition programs. The ACAT Level I programs are called Major Defense Acquisition Programs (MDAPs) while the ACAT Level II programs are labeled major acquisition programs.

Glossary

A&T	Acquisition and Technology
AT	Advanced Technology
ACAT	Acquisition Category
ACSC	Air Command and Staff College
ACTD	Advanced Concept Technology Demonstration
CAIV	Cost as an Independent Variable
CEP	Circular Error Probable
CINC	Commander in Charge
CONOPS	Concept of Operations
DAB	Defense Acquisition Board
DARO	Defense Airborne Reconnaissance Office
DARPA	Defense Advanced Research Projects Agency
DOD	Department of Defense
DODD	Department of Defense Directive
DRB	Defense Resources Board
DSMC	Defense Systems Management College
DUSD(A&T)	Deputy Under Secretary of Defense (Acquisition & Technology)
DUSD(AT)	Deputy Under Secretary of Defense (Advanced Technology)
EMD	Engineering, Manufacturing, and Development
EO	Electro-Optical
FAR	Federal Acquisition Regulation
Ft msl	Feet Mean Sea Level
FYDP	Future Years Defense Program
GMTI	Ground Moving Target Indicator
HAE	High Altitude Endurance
IFF	Identification Friend or Foe
IPT	Integrated Process Team
IR	Infra-Red

JPO	Joint Program Office
JROC	Joint Requirements Oversight Committee
JSTARS	Joint Surveillance and Target Attack RADAR System
LRIP	Low Rate Initial Production
LOS	Line Of Sight
LTG	Lieutenant General
Mbps	Mega-bytes per second
MDA	Milestone Decision Authority
MNS	Mission Need Statement
MOE	Methods of Evaluation
NIIRS	National Intelligence Imagery Rating System
nm	Nautical Miles
NRE	Non-Recurring Engineering
OIPT	Overarching Integrated Process Team
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
OT&E	Operational Test and Evaluation
PPBS	Planning, Programming, Budget System
PDRR	Program Definition and Risk Reduction
R&D	Research and Development
PPBS	Planning, Programming, Budget System
RDT&E	Research Development, Test and Evaluation
RM&A	Reliability, Maintainability, and Availability
RPV	Remotely Piloted Vehicle
RSTA	Reconnaissance, Surveillance, Target Acquisition
SAB	Scientific Advisory Board
SAR	Synthetic Aperture Radar
SES	Senior Executive Service
STA	Surveillance & Target Acquisition
SOCOM	Special Operations Command
TUAV	Tactical Unmanned Aerial Vehicle
UAV	Unmanned Aerial Vehicle
UFP	Unit Flyaway Price
USACOM	United States Atlantic Command
USSOCOM	United States Special Operations Command

Bibliography

"1995 National Security Science–Technology Strategy: New Ways of Doing Business." n.d. n.p. On-line. Internet, 10 December 1997. Available from http://www.whitehouse.gov/WH/EOP/OSTP/nssts/html/chapt2-2.html#mm18.

"ACTD Transition Guidelines." Deputy Undersecretary of Defense for Advanced Technology web site document, n.d., n.p. On-line. Internet, 10 December 1997. Available from http://www.acq.osd.mil/at/transtoc.htm.

"Advanced Concept Technology Demonstrations (ACTD)." n.d., n.p. On-line, Internet, 10 December 1997. Available from http://155.219.30.130/st/ACTD.HTM.

"Air Combat Command Concept of Operations for Endurance Unmanned Aerial Vehicles." HQ ACC/DO document, 3 December 1996. On-line. Internet, 5 December 1997. Available from www.acc.af.mil/do/dou/conops.htm.

Armitage, Sir Michael. *Unmanned Aircraft*. Washington: Brassey's Defence Publishers, 1988.

"Army will conduct "Make or Break" Testing of Outrider in March." *C4I News*, 15 January 1998, 8.

Biass, Eric H. and Braybrook, Roy. "Northrop Grumman Joint Stars." *Armada International*, May 1997, 50-55.

Cahlink, George. "Concerns Raised Over Reduced Time, Scope for Outrider ACTD Assessment." *Inside Washington*, 20 January 1998, 6.

Defense Airborne Reconnaissance Office, "UAV Annual Report, FY 1997" Washington, D.C.: Defense Airborne Reconnaissance Office, 6 November 1997. On-line. Internet, 1 March 1998. Available from http://www.acq.osd.mil/daro/uav97/toc.html.

Defense Airborne Reconnaissance Office, "UAV Annual Report, FY1996" Washington, D.C.: Defense Airborne Reconnaissance Office, 6 November 1996. On-line. Internet, 10 December 1997. Available from http://www.acq.osd.mil/daro/homepage/ uav96/content.html.

Department of Defense. *Joint Vision 2010*. Washington, D.C.: Joint Chiefs of Staff, 1996.

Department of Defense. "Rules of the Road: A guide for Leading Successful Integrated Product Teams." USD(A&T) document, November 1995.

DOD Directive 5000.1. *Defense Acquisition*, 15 March 1996.

DOD Regulation 5000.2-R. *Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs*, 06 October 1997.

"Draft Initial Requirements Document, CAF 003-90-I-B, for the High Altitude Endurance Unmanned Aerial Vehicle/System (HAE UAV)." HQ ACC/DRR-SMO-U document, n.d..

Fulghum, David A. "Unmanned 'Spies' to Tune in Bosnia." *Aviation Week and Space Technology*, 29 April 1996. 58-59.

Fulghum, David A. "Global Hawk UAV May Fly Early." *Aviation Week and Space Technology*, 29 April 1996. 24-26.

Fulghum, David A. "Outrider UAV Tackles Army, Navy Requirements." *Aviation Week and Space Technology*, 22 July 1996. 70-71.

Fulghum David A. "USAF Sees New Roles For Airborne Laser." *Aviation Week and Space Technology*, 7 October 1996. 26-27.

"FY98 Advanced Concept Technology Demonstrations Announced." 21 November 1997, n.p. Online. Internet, 10 December 1997. Available from www.dtic.mil/defenselink.

"Global Hawk Completes First Flight." *Air Force News Service*, 2 March 1998, n.p. On-line. Internet, 5 March 1998. Available from HTTP:/www.af.mil/news/Mar1998/ n19980302_980276.html.

Goodman, Glenn W. "Relying on Drones: Predator Shows the Way for Three Other New Military UAVs." *Armed Forces Journal International,* May 1997. 30-32.

Green, Gerald. "Outrider Tactical UAV First Flight Scheduled for November." *Unmanned Systems,* summer 1996. 41-42

Green, Gerald. "Predator UAV Continues Bosnian Surveillance." *Journal of Electronic Defense*, July 1997. 14.

Green, Gerald. "Unmanned Systems Gain Support in Military, Congress." *Unmanned Systems,* winter 1996-1997. 38-39.

Green, Jerry. "One-Year Moratorium on New-Start UAV Program Declared by Senate Appropriations Committee." *Unmanned Systems*, summer 1997. 31.

Green, Jerry. "House NSC Recommends Abolishing DARO and Shifting Recon to DIA." *Unmanned Systems*, summer 1997. 30-31

Green Jerry. "Predator Approved for Production." *Unmanned Systems*, summer 1997, 32.

Grimes, Vincent P. "Drone Aircraft Builders Expect Market Growth." *National Defense,* November 1996. 38-39.

"Guidelines for ACTD Implementation Directives." Deputy Undersecretary of Defense for Advanced Technology web site document, n.d., n.p. On-line. Internet, 10 December 1997. Available from http://www.acq.osd.mil/at/a2.htm.

"Guidelines for ACTD Management Plans." Deputy Undersecretary of Defense for Advanced Technology web site document, n.d., n.p. On-line. Internet, 10 December 1997. Available from http://www.acq.osd.mil/at/a3.htm.

Heber, Charles E., director, High Altitude Endurance Unmanned Air Vehicle (HAE UAV) Program Office, Defense Advanced Research Projects Agency (DARPA). "Prepared Statement before the Senate Armed Services Committee, Subcommittee on Airland Forces." Washington D.C. March 29, 1996, n.p. On-line. Internet, 1 March 1998. Available from http://web.lexis-nexis.com/congcomp/document.

"High Altitude Endurance UAV." Deputy Undersecretary of Defense for Advanced Technology web site document, n.d., n.p. On-line. Internet, 10 December 1997. Available from http://www.acq.osd.mil/at/hae.htm.

"High Altitude Endurance Unmanned Aerial Vehicle Program (HAE UAV) Advanced Concept Technology Demonstration Management Plan." HAE UAV Program Office document, 27 June 1997.

Kaminski, Paul G. Statement of The Under Secretary of Defense for Acquisition and Technology before the Acquisition and Technology Subcommittee of the Senate Committee on Armed Services on Defense Acquisition Reform, Washington, D.C., 19 March 1997, n.p. On-line. Internet, 10 December 1997. Available from www.acq.osd.mil/ousda/testimonies/def_acq_reform.html.

Kaminski, Paul G., Under Secretary of Defense for Acquisition and Technology, Office of the Secretary of Defense. Memorandum. To the Defense Acquisition Community. Subject: Update of the DOD 5000 Documents, 15 March 1996.

Klass, Philip J. "Military Users to 'Try before Buying.'" *Aviation Week and Space Technology*, 18 April 1994. 24.

Krulak, Gen Charles C., commandant of the United States Marine Corps. "Riding the Dragon into the 21st Century, Innovation and UAVs in the United States Marine Corps." *Unmanned Systems*, summer 1996. 9-13.

Lynn, Larry. "Advanced Concept Technology Demonstrations: Today's Technology for the Warfighter." *Army RD&A*, September-October 1995, 4-6. On-line. Internet, 10 December 1997. Available from http://155.219.30.130/st/LLYNN.HTM.

"Medium Altitude Endurance UAV, Predator." Deputy Undersecretary of Defense for Advanced Technology web site document, n.d., n.p. On-line. Internet, 5 December 1997. Available from http://www.acq.osd.mil/at/mae.htm.

"Navy VTOL UAV Decision Likely This Summer." *Aerospace Daily*, 20 January 1998. 87.

Olivieri, Frank. "Who Will Control Spy Planes?" *Air Force Times,* 28 August 1995. 23.

Packard Commission. *A Report to the President on Defense Acquisition, A Formula for Action*. Washington, D.C., April 1996.

"Pentagon invests $1 billion in ACTDs." *Aviation Week and Space Technology*, 31 July 1995. 55.

"Predator Unmanned Aerial Vehicle, Operations." Joint Program Office web site document, n.d., n.p. On-line. Internet, 5 December 1997. Available from http://www.peocu.js.mil/ Predator/INDEX.HTML.

"RDT&E Budget Item Justification Sheet (R-2 Exhibit): Advanced Concept Technology Demonstrations." OSD FY 1996 President's Budget documentation, Washington, March 1996.

"Reengineering the Acquisition Process, An Interview with Dr. Paul G. Kaminski, Under Secretary Of Defense for Acquisition and Technology." *Armed Forces Journal International*, June 1997. 54-55.

Richardson, Doug. "Unmanned Aerial Vehicles Stretch their Wings." *Armada International,* October-November 1996. 6-8.

Rodriques, Louis J., director, defense acquisitions issues, United States General Accounting Office. "Unmanned Aerial Vehicles, DOD's Acquisition Efforts." GAO Report GAO/T-NSIAD-97-138. Testimony before the Subcommittees on Military Research and Development and Military Procurement, Committee on National Security, House of Representatives, 9 April 1997.

Sheldon, Jim. "Role of Science and Technology Activities." Defense Systems Management College, Acquisition Policy Department Teaching Note, Acquisition Policy Advanced Program Management Course (APMC) 97-1, 1 December 1996.

Sherman, Jason. "Flight of the Outrider: The Pentagon's Top-Priority UAV Program Pushes Forward after a Rocky Start." *Armed Forces Journal International,* May 1997. 28-29.

Sommer, Geoffrey, et al. *The Global Hawk Unmanned Aerial Vehicle Acquisition Process*. RAND Report 19970221. Santa Monica, Calif.: RAND, February 1997.

Strong, Rear Admiral Barton D. Prepared Statement before the Senate Armed Services Committee, Subcommittee on Airland Forces, Washington D.C., 29 March 1996, n.p. On-line. Internet, 5 December 1997. Available from http://web.lexis-nexis.com/congcomp/document.

"Tactical UAV Given New Life." *Marine Corps Gazette,* 4 July 1997. 4.

"UAV Programs Gain Congressional Support as Major Milestones Loom." *Journal of Electronic Defense*, February 1997. 16-17.

"Unmanned Aerial Vehicles and Drones." *Aviation Week and Space Technology,* 12 January 1998. 96-103.

"Unmanned Aerial Vehicles: Outrider Demonstrations Will Be Inadequate to Justify Further Production." Government Accounting Office Report NSIAD-97-153. Washington D.C.: Government Printing Office, 23 September 1997.

Westcott, Lt Col Philip R. "Advanced Concept Technology Demonstrations (ACTDs): Can They Streamline the Joint Acquisition Process?" Carlisle Barracks, PA. U.S. Army War College, 15 April 1996.

Worch, P. *Report on UAV Technologies and Combat Operations*. United States Air Force, Scientific Advisory Board Report SAB-TR-96-01. Washington, D.C., November 1996.

Zaloga, Steven J. "UAV Military Future Deemed Promising." *Aviation Week and Space Technology,* 13 January 1997. 89-90.

Zaloga, Steven J. "UAVs Gaining Credibility." *Aviation Week and Space Technology*, 12 January 1998. 93-95.

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