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## SUMMARY

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The United States has seen a three-decade-long history of poor outcomes in unmanned aerial vehicle (UAV) development efforts. Technical problems have led to cost and schedule increases as well as to disappointing operational results. Costs have tended to escalate so much during development that the resulting systems have cost more than users have been willing to pay, precipitating program cancellation in almost every case. This history prompted the unique developmental approach adopted at the beginning of the High-Altitude Endurance Unmanned Aerial Vehicle (HAE UAV) Advanced Concept Technology Demonstration (ACTD) program.

There has also been a long history of efforts made to improve the efficiency and effectiveness of weapon system acquisition policy, processes, and management for all weapon system types. Capturing the experience from ongoing or recently completed efforts employing nonstandard or innovative acquisition strategies can facilitate such improvements. This research contributes to that effort.

In 1994, the Defense Advanced Research Projects Agency (DARPA), in conjunction with the Defense Airborne Reconnaissance Office (DARO), began the development of two UAVs. These systems were intended to provide surveillance information to the warfighter. As such, they responded both to the recommendations of the Defense Science Board and to operational needs stated by DARO on behalf of military service users.<sup>1</sup>

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<sup>1</sup>See also *Long Endurance Reconnaissance, Surveillance, and Target Acquisition (RSTA)* (JROCM-003-90, 1990), which documents a need to provide commanders in chief

The HAE UAV ACTD program consisted of two complementary system development efforts: the conventionally configured Tier II+ and the Tier III-, which incorporated low-observable (LO) technology into the design of the air vehicle. The program also included a common ground segment (CGS) that was intended to provide launch, recovery, and mission control for both air vehicles. The ACTD program was structured into three phases. Phase I was a design competition for the conventional Tier II+ system. Phase II included the development and test of both the Tier II+ (Global Hawk) and the LO Tier III- (DarkStar). Phase III involved the demonstration and evaluation (D&E) activity leading to a military utility assessment (MUA).

RAND has been analyzing the execution of the HAE UAV ACTD program's innovative acquisition strategy since the program's inception in 1994. The objective of this research was twofold: to understand how the innovative acquisition strategy used in the HAE UAV ACTD program affected the program's execution and outcomes, and to identify lessons that might be applied to a wider variety of programs in order to improve DoD acquisition strategies. Previous reports have documented the effects of that innovative acquisition strategy on Phase I and Phase II of the ACTD program.<sup>2</sup> The current research addresses the completion of Phase II, the transition to Phase III, and the transition to post-ACTD activities.

The HAE UAV ACTD program included two challenging management transitions. The first was the transition of management responsibility from DARPA to the Air Force within the ACTD program. The second was the transition from an ACTD to a Major Defense Acquisition Program (MDAP) under Air Force management. Both transitions affected and were affected by the program's unique and innovative acquisition strategy. The ability to accomplish these

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(CINCs) with responsive, long-endurance near-real-time RSTA capability against defended areas; *Assured Receipt of Imagery for Tactical Forces* (JROCM-044-90, 1990), which documents a need for rapid, effective, and continuous dissemination of imagery; and *Broad Area Coverage Imaging* (JROCM-037-95, 1995), which documents a need for on-demand, near-real-time battlefield imagery.

<sup>2</sup>See Geoffrey Sommer, Giles K. Smith, John L. Birkler, and James R. Chiesa, *The Global Hawk Unmanned Aerial Vehicle Acquisition Process: A Summary of Phase I Experience*, MR-809-DARPA, Santa Monica: RAND, 1997; and Jeffrey A. Drezner, Geoffrey Sommer, and Robert S. Leonard, *Innovative Management in the DARPA High Altitude Endurance Unmanned Aerial Vehicle Program: Phase II Experience*, MR-1054-DARPA, Santa Monica: RAND, 1999.

transitions smoothly was critical to the program's success. This report explores these two challenging transitions within the context of the innovative acquisition strategy used in the program. The goal is to understand the impact of that strategy on transition management issues.

The HAE UAV ACTD program transitioned from DARPA to Air Force management on October 1, 1998, approximately one year later than planned. At the time, Global Hawk air vehicle 1 had completed five airworthiness/functional checkout sorties for a total of 20.5 flight hours; air vehicle 2 was still two months from its first flight. DarkStar had resumed flight testing with air vehicle 2 only five months earlier and had completed only three sorties accumulating 2.26 total flight hours. Phase III start was still nine months away (the first D&E flight was June 19, 1999), imposing an added delay on the slip in management transition; the program was supposed to have transitioned to Air Force management at the beginning of Phase III.<sup>3</sup> Post-ACTD planning had not yet been approved, although some small related efforts were under way in connection with the transition activities just completed. The Australian demonstration was still in the early planning and feasibility stages. When the program transitioned to the Air Force, the ACTD program was planned for completion in June 2000. The MUA was to be produced by the Joint Forces Command (JFCOM) at that time.

Two years later, in October 2000, the ACTD program was essentially complete, and a positive MUA report had been issued by JFCOM.<sup>4</sup> The program office was working toward a Milestone II/low-rate initial production (LRIP) decision scheduled for that month to approve entry into an initial one-year engineering and manufacturing development (EMD) program. Further work was to be based on spiral development, an approach consistent with evolutionary acquisition in which continuing nonrecurring engineering activities result in scheduled block upgrades. The October 2000 Defense Acquisition

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<sup>3</sup>Interestingly, this desynchronization of management and phase transition had the effect of clouding the actual transition to Phase III activities. Phase III D&E planning took place throughout the year prior to the formal start of Phase III in June 1999.

<sup>4</sup>JFCOM is the renamed United States Atlantic Command (USACOM) with additional responsibilities in requirements development and experimentation. The final MUA was dated September 2000.

Board (DAB) II was delayed until December 2000 as a result of continued disagreement regarding the specifics on the evolutionary approach (i.e., on the requirements and capabilities associated with each block as well as on timing and quantities). The December 2000 DAB did not take place. The Milestone II decision finally came on March 6, 2001.

Over its 30 months of managing the ACTD program prior to Milestone II, the Air Force program office was occupied with three simultaneous primary management tasks: conducting the flight test program; planning for a transition from ACTD to the traditional acquisition process; and requirements generation and concept-of-operations (CONOPS) development, especially as it related to post-ACTD activities. In all these efforts, the innovative acquisition approach that characterized the program under DARPA management continued to have a significant effect on program management, events, and outcomes. In particular, the program's designation as an ACTD, its use of Section 845 Other Transaction Authority (OTA), and the lack of firm performance requirements had the greatest influence on the two management transitions.

Residual assets at the end of the ACTD included four Global Hawk air vehicles, two synthetic aperture radars (SARs), one integrated sensor suite (ISS) (acquired after the destruction of the first ISS), two mission control elements (MCEs), and three launch and recovery elements (LREs). Two additional air vehicles (air vehicles 6 and 7), built as part of the activities bridging the ACTD and MDAP programs, will be delivered in FY 2002; these will have a somewhat different configuration than previous air vehicles, requiring modifications to the ground segments.

Overall, the innovative acquisition strategy used in the HAE UAV ACTD program had a positive effect on program execution. Although the strategy can be improved, we believe that it was successful in accomplishing the program's main goals: demonstrating a new capability and operational concept at a lower cost and in a shorter time frame than would a traditional acquisition program. More significantly, the innovative approach used in the HAE UAV ACTD program allowed for the introduction of a new capability to the operational forces—an outcome that would have been highly unlikely under traditional approaches.

Although both transitions were ultimately successful, the transition from the ACTD construct to an MDAP using traditional processes was clearly the more challenging. Many of those challenges were a direct result of the acquisition strategy:

- The ACTD construct intentionally focused program activities on demonstrating the military utility of a new capability, technology, or operational concept while limiting activities related to operations and supportability. Supportability is a legitimate concern of the force provider (operational user), as is CONOPS. This critical difference in focus led to some problems in Global Hawk's transition to an MDAP, particularly with respect to the defining of operational requirements and block upgrades.
- The ACTD construct has a bias toward transitioning directly into low-rate production of the ACTD configuration.<sup>5</sup> While this may make sense for some systems (e.g., unique command-and-control systems or software development), it is not appropriate for a complex system such as Global Hawk. This raises the issue of how to transition into an MDAP-style development program that takes advantage of the technical maturation that has already occurred under an ACTD. A related issue concerns the timing of funding and program go-ahead decisions (i.e., military utility decisions); there is a conflict between the information available from the ACTD at any point in time and that required to program for and fund large, complex systems in the two-year Planning, Programming, and Budgeting System (PPBS) cycle.
- The use of OTA does not appear to have greatly affected either transition. The inherent flexibility of OTA helped program management deal with the uncertainty surrounding Global Hawk's transition to MDAP status. While both the program office and the contractor expended significant effort transitioning management processes from the contractor-dominated processes under OTA to more traditional processes under the Department of Defense (DoD) 5000 series policy, the costs of those efforts are unknown. We do know that the

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<sup>5</sup>See "ACTD Guidelines, Transition," October 1999, available at [www.acq.osd.mil/actd/guidelns/](http://www.acq.osd.mil/actd/guidelns/).

contractor and the Global Hawk System Program Office (GHSPO) spent considerable effort on those activities.

- Similarly, the use of Integrated Product and Process Development/Integrated Product Team (IPPD/IPT) processes eventually led to a strong collaborative working relationship between contractor and government, thus facilitating both transitions.
- Early user participation was a core purpose of the ACTD. Problems arose in the transition from ACTD to MDAP only because the change in status also involved a transition of users from JFCOM to the Air Combat Command (ACC). These users have very different perspectives, different definitions of military utility (affecting operational requirements and concepts), and different preferences with regard to system configurations and capabilities. Current ACTD and MDAP policy and practice do not have well-defined mechanisms for addressing the conflicts that may arise from these differing perspectives.
- The lack of firm performance requirements throughout the ACTD program resulted in some difficulty in defining operational requirements for the MDAP program. Yet the lack of specific performance requirements is a hallmark of ACTDs and is the reason such efforts can demonstrate new technology, capabilities, and operational concepts. While we acknowledge the difficulty the operational user had in defining and gaining approval of an operational requirement, we believe that modifying this aspect of the ACTD construct would result in a substantial loss of benefits.

## **RECOMMENDATIONS FOR FUTURE PROGRAMS**

Cost and schedule were essentially fixed in the HAE UAV ACTD program, with performance having some degree of flexibility. We believe that cost, schedule, and performance should all be stated as goals to be traded off within identified bounds. This allows more intelligent trade-offs to be made, leading to more cost-effective solutions. When one or more of these parameters are fixed, the program becomes highly constrained and may not produce optimal trade-offs. Of course, this requires that the acquisition and user communi-

ties show flexibility in requirements and operational concepts, total development budgets, and program schedules.<sup>6</sup> Such flexibility would have facilitated the transition to MDAP status.

In future programs, all organizations with an interest in the program, both in the current phase and in later phases, should have significant input into early planning. Perhaps the dominant problem Global Hawk overcame lay in the fact that key elements of the Air Force—particularly the operational users (ACC)—did not buy into the program. Had these elements been involved up front, the effort might have seen a smoother program execution and transition into the force structure. Early management plans should make it clear that the designated lead agency for post-ACTD activities should fund the operationalization of the system and define a role for the operational user supporting the ACTD-designated commander in chief (CINC) user.

In future programs, operational users must also be incorporated into program decisions and processes at an earlier juncture, as it is these users who have both the resources and the knowledge to actively participate in the development process. Users must include both those who will operate the system and those who will integrate that system into overall warfighting efforts. In most cases, these are different communities or organizations with different perspectives, cultures, and needs. In a similar manner, attention must be paid to the valid requirements and desires of both sets of users. Finally, a mechanism should be put in place to quickly resolve conflicts between the two cultures. We acknowledge, however, that the incorporation of operational users into early programmatic decisions is difficult and that there are very few successful cases from which lessons can be derived. At the same time, the fundamental problems that arose in Global Hawk point to differences in cost/performance/schedule trade-offs. It may be possible to smooth the transition from ACTD to MDAP through earlier use of formal system engineering studies to illuminate these trade-offs to all parties, as well as through frequent updating of those analyses as real experience is gained.

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<sup>6</sup>It is not within the power of program offices and warfighters to change annual program budgets in any significant way. Thus, cost increases can be accommodated only via schedule stretches.

A mid-ACTD program review addressing many post-ACTD program decisions would also help smooth program transitions. Basic flight testing provides a sense of the utility and direction of a post-ACTD program. Should such a program seem likely, its basic outline could be determined, allowing more time to align the expectations of current and future program participants. We note that had the original 24-month D&E phase been carried out, there would have been substantially more time to conduct a mid-ACTD program review based on preliminary flight testing, as well as more time to align the future program with the program objective memorandum (POM) budgeting cycle.

Perhaps the most important improvement to the acquisition approach would involve the establishment of a process to manage the expectations of the various organizations involved in the program. In particular, expectations regarding the possible entry point of the system into the acquisition process should be thoroughly vetted. We observe that DARPA, JFCOM, and the Air Force and Office of the Secretary of Defense (OSD) acquisition communities were strongly biased in favor of entering the acquisition process at LRIP, with varying degrees of modification. Current ACTD guidance on transitions supports this bias. However, the bias is unwarranted. Given both the technical and operational characteristics of the HAE UAV system, it should have been clear from the start that any transition would require further development, perhaps to a significant extent. The acquisition community should recognize that an important result of this type of approach might be the transfer of knowledge in the form of new operational concepts, ideas, and technologies. The user community should for their part recognize that not all systems developed elsewhere are inherently bad.