

Critics of the ACTD construct, particularly in Congress, note that ACTDs provide a mechanism for initiating system development without all the normal approvals usually applied to MDAPs. Critics of OTA use believe that government interests are not adequately protected under the more relaxed management processes inherent in OTA implementation, maintaining that such processes bypass many of the traditional checks and balances of the acquisition process. Additionally, if an ACTD were not a formal acquisition program but would eventually transition into one, questions remain regarding how issues of funding, requirements, and integration into operational use should be addressed. These issues persist seven years after the beginning of the HAE UAV ACTD. Two issues in particular have yet to be resolved: the relationship of an ACTD program to the traditional acquisition process, and the affordability and integration of Global Hawk into the force structure within the context of an existing U-2 force with known capabilities.

IMPACT OF THE HAE UAV ACTD'S INNOVATIVE ACQUISITION STRATEGY

For the most part, we believe that the transition of management responsibility from DARPA to the Air Force within the ACTD program was not significantly affected by the innovative acquisition strategy used in the HAE UAV ACTD program. In fact, the program plan both called for and made provision for that management change. DARPA management was the only way to initiate the program using OTA: The 1994 public law provided OTA solely to defense agencies. Some

three years later, the law was extended to the military services, allowing management under OTA to continue when the program transitioned to the AF.

Several elements of the innovative acquisition approach used during the ACTD program directly affected both the transition to the formal acquisition process and the introduction of Global Hawk into the operational forces. In particular, several elements of this strategy resulted in substantial challenges for the transition to an MDAP: designation as an ACTD, use of OTA, early user involvement, and the lack of performance requirements.

Designation as an ACTD

A 1999 U.S. General Accounting Office (GAO) report suggests that the ACTD concept was still not well understood as late as 1998. This ambiguity was said to stem from confusion regarding whether an ACTD is a technology development effort or a system development program.¹ Related issues include the use of mature technology (which might still have a significant integration challenge), the need to demonstrate operational characteristics, and the lack of production or suitability testing. This GAO report lends support to the notion that the ACTD concept is plagued by internal conflicts—conflicts that clearly affected the HAE UAV ACTD program, particularly in terms of the transition to an MDAP.

The ACTD designation constrained MDAP transition planning until very late in the process and created a challenging budgeting problem for the future. In addition, the roles of the ACTD and MDAP users were ambiguous and even conflicting, thereby contributing to tension and uncertainty with regard to future performance and CONOPS.

Any transition from development to production requires that production funds be budgeted at least two years ahead of time (a single PPBS cycle takes two years). In longer development programs, service users have more time to gain familiarity with the system and to

¹See U.S. General Accounting Office, “Defense Acquisition: Advanced Concept Technology Demonstration Program Can Be Improved,” GAO/NSIAD-99-4, October 1998.

become comfortable with its characteristics and expected capabilities. In the current case, the HAE UAV's ACTD status placed it outside the normal POM/PPBS process guiding production funding. Budgeting problems were complicated by the fact that the Air Force did not decide to pursue Global Hawk until around January 1999, when it canceled DarkStar in order to focus resources on Global Hawk. At that time, funding for the program was added to the Air Force FY 2000 POM. Program funding prior to that time had derived first from DARO and DARPA and later from DARPA and from funds transferred to the Air Force from DARO when the latter was stood down.

While an ACTD is not formally an acquisition program, in this instance it is a new approach to the design, development, and test of representative systems. Although an ACTD concludes in a military utility decision by the designated user, there has not been a corresponding change in the requirements and funding processes. The POM process requires inputs two years before the military utility decision marking ACTD completion. Placing a budget wedge in the POM requires convincing Congress; the wedge may disappear if the program is terminated, becoming unavailable for reallocation within the lead service. This is potentially a high budget risk, particularly if the ACTD program would eventually lead to the replacement of an existing program and thus directly compete for resources. This issue is compounded if the ACTD did not originate in the military service. Both of these constraints apply in the case of Global Hawk. The ACTD designation was a significant factor underlying much of the difficulty encountered in defining a post-ACTD program.

The ACTD program resulted in a Global Hawk system of significant maturity (and allowed the cancellation of the more immature DarkStar). This could lead to significant cost and schedule savings in EMD relative to a more traditional approach; post-ACTD activities can be highly tailored to build on what has already been achieved, including a modified development test/operational test (DT/OT) program. Obtaining those benefits requires that the user community (both product users and operators) agree that the baseline ACTD configuration has military utility and provides a strong foundation for subsequent improvements in capabilities. By its very definition and nature, an ACTD is not a development program leading to the direct replacement of an existing capability and should not be

treated as such. This continues to be a major problem for Global Hawk. Although an ACTD program has an important role in demonstrating new technologies or operational concepts, for complex systems such as Global Hawk there should be no expectation of transitioning directly to production; some additional development will be required and should be planned from the outset.

One possible reason the implications of the ACTD designation have been so troubling for Global Hawk pivots on the uniqueness of the HAE UAV program as an ACTD. The expected total cost of the HAE UAV program accounted for 37 percent of the total expected cost of the ACTDs initiated in FY 1995. The HAE UAV program accounted for 18.7 percent of the total expected cost of the 46 ACTDs initiated through FY 1998.² The HAE UAV program is clearly much larger than most ACTDs; of the 46 such programs initiated through FY 1998, only five had expected total costs greater than \$200 million. Additionally, the HAE UAV ACTD program in general and Global Hawk in particular appear very close to the type of complex system development normally undertaken in the traditional acquisition process. A review of 16 completed ACTDs initiated through FY 1997 indicates that most of the efforts resulted either in a useful residual capability that satisfied the need (no additional production was required) or in the transfer of ideas or technology into emerging weapon system concepts. Finally, the bias inherent in ACTD guidance toward LRIP as the transition point—reflected in the way the HAE UAV ACTD was executed—implies that little thought is given to post-ACTD development activities that might be either needed or desired by the actual operational user in order to make the system acceptable.

This leads to an important issue that we offer for consideration. Given the tremendous challenges of transitioning an ACTD to a traditional acquisition process with entry at EMD, we must ask whether the benefits of an ACTD are really associated with the specific hardware/software system used to demonstrate military utility or, alternatively, whether its true benefits lie in less tangible areas of technology, knowledge, and operational concepts. If the real benefit of an ACTD is knowledge-based rather than hardware-based, then it

²See Congressional Budget Office, "The Department of Defense's Advanced Concept Technology Demonstrations," 1998.

would be possible to obtain those benefits even if we started over with a new design competition. Some of the management lessons tied to other elements of the HAE UAV ACTD program's innovative approach could be applied to that new program.

The ACTD concept, as implemented in the HAE UAV ACTD program, had some significant flaws that reduced the transfer of benefits and experience from ACTD to post-ACTD activities. ACTD transition guidance leans strongly toward transition to LRIP, with very little in the way of lessons or suggestions for transitioning to EMD. The fact that so many items important to operational systems are neglected during the ACTD program (e.g., maintainability, reliability, training, and documentation) strongly suggests that for a complex program such as the HAE UAV ACTD, the more realistic expectation is transition to EMD. The original HAE UAV ACTD program anticipated a Phase IV production phase in which an additional ten air vehicles of each type would be procured. This may have been a useful way to define and control costs, but it was clearly an unrealistic expectation.

The evolutionary acquisition approach that is being used in Global Hawk—and that was recently embodied in the DoD 5000 series of policy documents—raises the question, To what extent is an ORD really an ORD? In traditional programs, ORDs are developed and approved prior to program initiation and remain relatively static. Requirements are stated in terms of both thresholds (must-meet criteria) and objectives (we would eventually like to be at this higher level of performance). In evolutionary acquisition, the notion is to continuously improve performance by means of ongoing NRE activities using feedback from both fielded units and the test program. In this scenario, the ORD would evolve along with the system's capabilities. Evolutionary acquisition seems better suited to an approach such as that of the system capability document (SCD), which was pioneered in the now-defunct Arsenal Ship program.³ This approach, which provided broad outlines for the capabilities that were sought from the system, was easily changeable as the program evolved. The capabilities described in the SCD would be different for

³See Robert S. Leonard, Jeffrey A. Drezner, and Geoffrey Sommer, *The Arsenal Ship Acquisition Process Experience: Contrasting and Common Impressions from the Contractor Teams and Joint Program Office*, MR-1030-DARPA, Santa Monica: RAND, 1999.

the ACTD-, Spiral 1-, and Spiral 2-configured Global Hawk air vehicles. The SCD concept seems appropriate for use DoD-wide given the spiral development approach currently being embraced for weapon system development.

The HAE UAV ACTD program was clearly affected by the “not invented here” syndrome so common in the transfer of ideas, technologies, or processes between organizations. The Air Force did not conceive of or design the HAE UAV ACTD program. The innovative acquisition approach exacerbated this problem. OSD essentially forced the Air Force to accept the program. Important elements of the Air Force (ACC) were not involved until very late in the program, and even then, it was AC2ISRC—a relatively new organization within ACC that is responsible for ISR systems—that was involved with the program, not the wider operational Air Force.

Air Force acceptance of Global Hawk (and the HAE UAV in general) has been problematic; there was no mechanism in the Air Force to obtain support for the program because it fell outside the POM planning and budgeting cycle and represented a new capability and operational concept. Global Hawk had trouble gaining support in the ISR community because it was viewed as an unknown system competing against a known capability—the U-2. The joint community supported Global Hawk because it was an information-based platform that directly supports Joint Vision 2010. The acquisition community supported the program because it represented radical acquisition reform that worked. Without OSD direction, the required Air Force budget would not have been made available. Some program participants believe that without OSD direction, neither HAE UAV ACTD program would have survived.

ACTD programs often deemphasize logistics; such concerns were expressly not part of the original conception of the HAE UAV ACTD program. In some respects, an ACTD approach will always deemphasize reliability, maintainability, and supportability (RMS). RMS is best designed into a system up front because the redesign of a mature system is costly. In the case of Global Hawk, training, technical orders, and documentation for air vehicle support were limited, as were training and documentation for the ground segment. The contractors successfully supported flight testing, but their processes were not formally documented until toward the end of the ACTD.

There are no future plans to build an infrastructure to support the ACTD configuration, calling into question the Air Force's ability to utilize the program's residual assets. Logistics issues are only now being considered for Block 5 aircraft. Attaining a balance between an ACTD's focused effort to demonstrate the utility of a new technology or operational concept and the efficiencies gained by designing in supportability attributes remains a difficult challenge, and one that must be properly addressed within the context of each individual ACTD program.

Use of OTA

The transition from the management processes and cultural norms developed under the flexible OTA mechanism back to traditional FAR-based processes was expected to pose a major challenge. Yet while the challenge was considerable, the transition went remarkably smoothly, in part because the program office planned for it and in part because Northrop Grumman's expertise in FAR-based management was brought to Ryan through its acquisition by the larger firm. We note, however, that both the contractors and the program office spent significant time and energy transitioning back to FAR-based processes. As a result, substantial non-value-added costs were likely incurred, although the magnitude of such costs cannot easily be measured. The program office is currently in the position of executing side-by-side EMD efforts under OTA- and FAR-compliant processes. Its willingness to accommodate both processes rather than simply shifting all EMD activity to FAR compliance proves the significant advantages gained from operating under the permissive and flexible OTA construct.

Early User Involvement

The ACTD construct also includes early user participation. A critical issue in this context concerns defining who the user is and thus who has the responsibility and authority to determine system specifications and to judge military utility. In most programs, system specifications are a direct result of the performance thresholds stated in the ORD; the ORD is developed by the operational user (in this case ACC). In the HAE UAV ACTD program, no ORD was developed during the ACTD program, and a commander in chief, or CINC (JFCOM),

was the designated user. The differing perspectives of these two users result in very different criteria for evaluating the military utility of the system. Both criteria have validity, and both should thus be considered in determining military utility.

Further, the ACTD process itself introduces a different way of determining military utility. In an ACTD, utility is judged against demonstrated capabilities through use of basic criteria established earlier in the program. Those criteria may not incorporate all aspects of operational utility. In a traditional program, an ORD is developed against a mission need with detailed system specifications relating to specific performance attributes. The system is then designed to those specifications, and if the stated performance is demonstrated, utility is presumed. This process is conducted in the absence of information regarding technological feasibility, risk, and cost. Neither process can be considered “correct”; both have significant problems in execution and will produce different performance outcomes. However, the ACTD process—modified to include both the unified command (in this case JFCOM) and the force provider (in this case ACC) in the design and execution of D&E activity—has the potential to produce a better and more balanced performance outcome as well as to smooth the transition to an MDAP. At the same time, there is a risk that including the force provider early in the ACTD will diminish the innovation desired from the ACTD program.

Performance specification issues illustrate a critical challenge in the transition from an ACTD to an MDAP: the user also transitions. One aspect of this problem is illustrated as follows: AC2ISRC was responsible for drafting the ORD. An early draft ORD had 105 threshold requirements. By one estimate, Global Hawk would not have met 40 percent of those requirements in the Block 5 configuration. Had this situation remained, Global Hawk would have been set up for failure. In the acquisition community, many participants felt that the ORD should have been written to reflect the demonstrated capabilities of the ACTD configuration, with subsequent planned improvements implemented through the evolutionary approach. ACC was concerned that funds would not be forthcoming in the future to accomplish evolutionary acquisition; corporate Air Force support did not exist to ensure incremental funding.

In light of the experience of the HAE UAV, the notion of early user participation in ACTDs would appear unrealistic in at least two ways. First, as discussed above, the ACTD designated user (a unified command) is not the same as the service user (operational commands). These two user communities have vastly different perspectives, roles, and capabilities. For the HAE UAV, the CINC (JFCOM) includes imagery analysts and force deployment decisionmakers; the operational user (ACC) is the force provider. For Global Hawk, the result was two differing sets of requirements suited to different CONOPS. Second, the CINC does not really have the resources and capabilities to support detailed technical interaction with the development community regarding desired capabilities and how those capabilities might be translated into performance characteristics. The service operational commands do have the resources and capabilities for this type of interaction.

Lack of Performance Requirements

A precise definition of military utility was not developed or communicated to the contractors until the publication of the integrated assessment plan in June 1998. This plan defined the MUA assessment process in detail, including the definition and metrics for military utility.⁴ This was very late in the development cycle for the HAE UAV systems, and in any case, the relative importance of the various objectives and capabilities was never established. This lack of definition of military utility hindered performance trade-offs throughout the program's life cycle, since the contractors did not know how the loss (or gain) of any particular capability would be viewed.

The requirement for a Single Unit Flyaway Price (UFP) left open the entire spectrum of technical (performance) requirements for the HAE UAV system.⁵ Unlike traditional programs, no requirements document was approved prior to RFP release and contract award

⁴See Drezner and Leonard, *Innovative Development: Global Hawk and DarkStar—Flight Test in the HAE UAV ACTD Program*, 2001, for a more detailed description of the MUA process.

⁵See Leonard and Drezner, *Innovative Development: Global Hawk and DarkStar in the HAE UAV ACTD—Program Description and Comparative Analysis*, 2001, for a complete discussion of the UFP requirement and its implications on the system's capabilities.

from which a system specification could be derived. A system specification forms the baseline configuration against which performance is measured in a traditional approach. Yet the system specification that was eventually developed for Global Hawk evolved largely after the system was designed.

Despite the various problems and challenges the HAE UAV ACTD program faced, one aspect that has received little attention is the fact that the program represents an important innovation in terms of capabilities, system type, and CONOPS. There is a strong belief among some in the science, technology, and acquisition community that the Air Force was initially resistant to the notion of stealth. The fundamental demonstrator programs proving and maturing LO technologies—Have Blue (which led to the F-117) and Tacit Blue (which indirectly led to the B-2)—were both DARPA programs. Despite a history of challenging transitions for such systems,⁶ many of the Air Force’s current ISR or “special duty” capabilities are embodied in systems whose basic technologies were developed in other organizations. These systems include the following:

- **E-3 Sentry:** A modified B-707 for airborne early warning, battle management, and command, control, and communications for tactical and air defense forces.
- **E-8 Joint Surveillance Target Attack Radar System (JSTARS):** A modified B-707 for ground surveillance, battle management, and command and control.
- **OC-135 Open Skies:** A modified C-135 reconnaissance aircraft for observation and verification flights over nations that are parties to the 1992 Open Skies Treaty.
- **RC-135 Rivet Joint:** A configured variant of the C-135 for real-time electronic signal reconnaissance.
- **RQ-1A Predator:** A medium-altitude, long-range reconnaissance UAV with multiple imagery sensors.

⁶For a history of technology transition challenges in DARPA, see Defense Advanced Research Projects Agency, *DARPA Technology Transition*, 1998, and Reed, Van Atta, and Deitchman, *DARPA Technical Accomplishments: An Historical Review of Selected DARPA Projects*, February 1990.

- **U-2 Dragon Lady:** An HAE reconnaissance aircraft carrying a wide variety of sensors and cameras.
- **WC-130:** A configured variant of the C-130 for weather reconnaissance.
- **E-9A:** A version of the de Havilland Dash 8 for over-the-horizon data gathering for missile tests.
- **EC-18B and D:** A modified Boeing 707 for telemetry and other data gathering to support the testing of aircraft, spacecraft, and missiles.
- **EC-130E Airborne Battlefield Command and Control Center (ABCCC) and EC-130J Commando Solo:** Modified C-130s for battlefield command, electronic warfare, and electronic combat.
- **EC-130H Compass Call:** Modified C-130s for electronic warfare/combat.
- **EC-135A/G/L and EC-135E Advanced Range Instrumentation Aircraft (ARIA):** Modified KC-135s for continuous airborne alert supporting national command and control. The ARIA version is used for telemetry data recording and voice relay.

The Predator was an earlier ACTD developed to fill the Medium-Altitude Endurance (MAE) UAV mission need. The U-2 was initially conceived and developed within the intelligence community. Of this list, two are ACTDs, several are commercial aircraft with equipment installed (B-707s or Dash 8), and several are modified C-130s or KC-135s. Mainstream service acquisition and operational communities have great difficulty adopting radical innovations, which is one of the reasons many of these innovations are developed and operated by special units.

Programs established outside the mainstream can greatly contribute to future service capabilities, and ACTD programs can be an important source of innovation, both technological and operational. The challenges Global Hawk faced in its transition reflect in part the difficulty any new technology faces upon its initial incorporation into a large institution.

Other Attributes of the Acquisition Strategy Affecting the Transitions

The use of IPPD/IPT processes appears to have had little effect on either transition. If anything, the collaborative relationship that developed between the contractor and the program office may have helped smooth those transitions.

The original DARPA HAE UAV JPO was in fact fairly small, consisting of a core of DARPA personnel supported by Air Force personnel from ASC/RAV and technical support contractors. At the time of the management transition, the Air Force program office was somewhat smaller than the DARPA JPO but subsequently grew considerably. The GHSPO (ASC/RAV) currently includes 78 Air Force personnel and technical support contractors—more than double the original size of the DARPA JPO but considerably smaller than that of most traditional programs. While this was a significant increase from prior years, some increase was clearly required. Planning for and conducting the Phase III D&E and the transition to MDAP status were new program office activities.

KEY ELEMENTS FOR SUCCESSFUL TRANSITIONS

The two different transitions that the HAE UAV ACTD program underwent present an interesting contrast. The transition of management responsibility from DARPA to the Air Force during the ACTD was remarkably smooth, especially given the poor historical experience in interagency program transfers. In contrast, the transition from ACTD to the formal acquisition process within the Air Force has been problematic despite the service's long history of successfully developing complex systems.

One explanation for this contrast is that the management transition from DARPA to the Air Force included many of the key elements required for a successful transition, while that from ACTD to MDAP violated many of these tenets. For example:

- **Early Planning:** The transition from DARPA to the Air Force was facilitated by early transition planning, which included both the DARPA and ASC/RAV program offices. Issues were raised and actions taken to resolve identified risks. In contrast, planning for

the transition from ACTD to MDAP began very late in the program—too late to resolve many of the critical issues that later became stumbling blocks (requirements and capabilities; funding and affordability).

- **Expectations and Formality:** The management transition from DARPA to the Air Force during the ACTD was planned from the outset. The transition was formally tied to a specific event, and criteria were defined to indicate the completion of that event. The ultimate decision was made by officials above the program office. In contrast, there was no agreed-upon expectation on the part of the Air Force that the program would transition into the formal acquisition process and, if it did, at what point. Further, there was no guidance and little experience to help smooth the entry of Global Hawk into the acquisition process. Nor was there any guidance or documentation on how to prioritize and resolve issues.
- **Sustained Top-Level Support from Participating Agencies:** DARPA maintained top-level support throughout the program, while Air Force support was nowhere near as strong. Within the Air Force, senior acquisition officials were more familiar with—and more supportive of—the program than were operational commanders.
- **Early Participation of Affected Organizations:** While ASC/RAV participated early in the program and supported the transfer of management responsibilities, ACC did not in fact support the transition of the program into the force structure. The HAE UAV ACTD program ran into trouble in the transition from ACTD status to the formal acquisition process in part because key elements of the Air Force—the operational user (ACC)—were not involved throughout the ACTD program. Had ACC been involved earlier, the performance of the resulting ACTD configuration might have been improved in key areas of concern to ACC (e.g., supportability), and the capabilities of the system might have been more familiar and therefore more acceptable.
- **Continuity:** The transition from DARPA to the Air Force occurred during the ACTD process at the beginning of a fiscal year. For the most part, funding issues and activity content (Phase II development testing and Phase III D&E testing) were already

agreed upon. The Air Force knew that it was responsible for funding Phase III D&E and thus programmed that money before the actual transfer of management authority.⁷ In contrast, an ACTD cannot enter into the acquisition process until the MUA is completed. Thus, a built-in gap of two years results from the POM budget cycle.

A key ingredient to improving the acquisition strategy applied to the HAE UAV ACTD program is to address these transition elements much earlier in the ACTD.

Most program participants agreed that post-ACTD planning cannot wait for the MUA decision to decide the next steps. In this sense, the original plan of the HAE UAV ACTD was not realistic. The POM process effectively adds two years to the planning cycle. Additionally, there are likely to be industry-base issues in any ACTD-to-MDAP transition, as was the case in Global Hawk.⁸ Transitioning thus requires the injection of post-ACTD planning into the ACTD program.

A mid-ACTD program review in which many of the decisions regarding a future program are made would seem likely to help smooth program transitions. Many of the basic outlines of a future program could be determined just after flight test begins, allowing for more time both to align the expectations of current and future program participants and to plan for future transitions in management responsibility, program phase, and technical and operational maturity.

Perhaps the most important improvement to the acquisition approach would involve the establishment of a process to ensure that the expectations of the various organizations involved in the program are aligned. 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 OSD acquisition communities were strongly biased toward entering the

⁷Funding for Phase III of the ACTD was transferred to the Air Force from DARO when the latter was stood down.

⁸Industry-base issues are commonly defined as those concerning funding gaps that would lead to a discontinuation of either development or production activities, with an associated risk of losing experienced personnel. These issues apply at both the prime and subcontractor levels.

acquisition process at LRIP with only minor modifications to the system. 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 and perhaps significant development; the program was too much like a traditional service program, and the system's mission area was too close to an existing system. The acquisition community should recognize that an important result of this type of approach might be the transfer of knowledge—new operational concepts, ideas, technologies. The user community should recognize that not all systems developed elsewhere are inherently bad.