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Intelligence Technology in the Post-Cold War Era: The Role of Unmanned Aerial Vehicles (UAVs)

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Intelligence Technology in the Post-Cold War Era: The Role of Unmanned Aerial Vehicles (UAVs)

SUMMARY

The post-Cold War Department of Defense (DOD) will be expected to operate in a different environment from that which has prevailed since the end of World War II. Operations, including peacekeeping and peacemaking responsibilities, may take place in any part of the world without an opportunity for extensive intelligence collection. Intelligence requirements for such operations will be different from the need for comprehensive data on Soviet and Warsaw Pact forces which was the focus of the U.S. Intelligence Community's efforts over four decades. In the post-Cold War era, intelligence will need to support a wider variety of operations in diverse areas than may have been the case in the past.

Cold war intelligence depended heavily upon extensive networks of ground systems to collect signals intelligence, satellites to collect photography and other forms of data, and human agents. Targets, though often difficult to penetrate, were widely known and agreed upon. Today's areas of concern, if less formidable than the Soviet Union, are less easily anticipated. Consensus that extensive intelligence resources should be permanently devoted to Country X or Region Y will likely be rare. There is, however, a consensus that intelligence and intelligence-related spending cannot expand to provide in-depth coverage of every potential trouble spot.

It is widely hoped that some of the variable needs of the future can be met by heavier reliance on new technology which can be deployed on short notice and will not involve the permanent commitment of many billions to hardware. Among the more interesting examples of new technology are unmanned aerial vehicles (UAVs)--small pilotless aircraft that can fly over areas of interest carrying sensors appropriate to a particular mission to gather data and transmit it back instantaneously. Much of the relevant technology has long been available and UAVs were used extensively in the Vietnam War. In the past decade, however, advanced surveillance and communications equipment have made possible flexible, useful, and cost-effective UAV systems that, it is urged, can supplement satellites, reconnaissance aircraft, human observers, and other sensors. They can be rapidly deployed and controlled by low-level tactical commanders and, importantly, can be sent over hostile territory with minimal danger of the capture or death of U.S. personnel. UAVs are not panaceas, however; other platforms have significant advantages and countermeasures may be developed.

Congress has strongly pushed for a DOD-wide UAV procurement effort to maximize use of commercially available technology and to ensure maximum interoperablity and compatibility. The procurement process, however, has been slow, expensive, and strongly criticized for delays and inefficiencies. Although there appears to be continued backing for UAV procurement, it can be expected that with budget reductions, such expenditures will receive even closer scrutiny.

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Intelligence Technology in the Post-Cold War Era: The Role of Unmanned Aerial Vehicles (UAVs)

INTRODUCTION

In the post-Cold War era, U.S. military forces, though much reduced in size, will be expected to operate in a variety of circumstances in various parts of the world. Essential to their effectiveness will be high-quality, timely intelligence on the areas where they operate and on potential enemies they are likely to encounter. Despite, or perhaps because of, shrinking budgets, the executive branch and Congress have indicated intent to take advantage of innovative technologies to enhance intelligence collection, analysis and dissemination capabilities. Among the more important examples of innovative intelligence technology are the combination of unmanned aerial vehicles (UAVs) with various types of reconnaissance and communications systems. UAVs, proponents argue, can provide more intelligence faster to tactical commanders than much of the current intelligence infrastructure and do so at costs that can realistically be accommodated within planned defense budgets.

Since 1988, UAV procurement has received close congressional oversight. A Joint Project Office (JPO) was created at congressional insistence to avoid duplication of effort among the UAV programs of the several services. According to critics, however, UAV programs have been plagued by delays and inefficiencies.

In the eyes of many, UAVs proved their worth during the Persian Gulf War by providing detailed, accurate and timely intelligence on Iraqi forces to Allied commanders. Given current efforts to reduce defense spending and acquisition difficulties, however, UAV programs may be cut back as they compete with other promising programs.

BACKGROUND

Plans for reshaping the U.S. Intelligence Community in the post-Cold War world emphasize reorganization and budgetary reductions. The significant growth of the U.S. intelligence effort during the 1980s clearly was not to be sustained once the Warsaw Pact had disbanded and the Soviet Union collapsed. Instead, the Clinton Administration and many in the 103rd Congress came into office in 1993 seeking major reductions in intelligence spending. A significant percentage of the intelligence budget has always been devoted to military intelligence and it was understood that budget reductions would have, in all probability, an important effect in this area.

The intelligence coverage that was directed at the Warsaw Pact and the Soviet Union involved satellites, ground and maritime observation posts, cultivation of human agents over long periods of time, and lengthy in-depth analytical assessments of economic and demographic trends. To support Administration policymaking and senior combat commanders, national (i.e., Washington-based) agencies were established and tactical intelligence assets were deployed by the military services using the full range of overhead photography, signals intelligence, human intelligence, and other systems. The result was encyclopedic, and, to some extent, knowingly redundant coverage of potential Soviet and Warsaw Pact threats to U.S. and NATO forces. This effort reflected a governmental consensus on the nature of U.S. interests, evident threats to those interests, and on the need to invest substantial resources over a period of decades.

The end of the Cold War has dramatically altered the work of the U.S. Intelligence Community; no longer are intelligence agencies focused on a potential military attack by the Warsaw Pact or the Soviet Union. Now, the United States sees potential need to move into a number of potential crisis areas to protect important interests, to ensure regional stability, or to protect beleaguered minorities. As the new Director of Central Intelligence, R. James Woolsey, colorfully suggested in his confirmation hearings: "Yes, we have slain a large dragon. But we live now in a jungle filled with a bewildering variety of poisonous snakes."[1]

Post-Cold War concerns are likely to be less easily anticipated and more diverse. Even without the determination to reduce defense and intelligence spending, the sheer diversity of U.S. interests would likely preclude both the type and the concentration of investment that characterized the Intelligence Community's efforts vis-à-vis the Warsaw Pact and the U.S.S.R. The engagement of U.S. military forces in various post-Cold War trouble spots, such as Iraq, Panama, Somalia, and perhaps at some point the Balkans, leads some observers to conclude that important requirements for military and military-related intelligence on a wide variety of countries will continue. There may well be a need for more extensive data bases covering the military geography, political structures and other aspects of regions where military operations are conceivable, but continuous in-depth monitoring of every part of the world is impossible. The Intelligence Community may be expected to be able to "get up to speed" on diverse areas on relatively short notice when it appear that there is a possibility that U.S. forces may become engaged in a spectrum of possible operations, including disaster relief, peacekeeping, peacemaking, low intensity warfare, as well as conventional campaigns. With reductions in the forward deployments of U.S. forces and perhaps less access to overseas bases, a larger percentage of U.S. forces may be based in the continental U.S. and will have to be prepared for operations in a variety of different areas.

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[1]Testimony of Director of Central Intelligence-designate R. James Woolsey before the Senate Select Committee on Intelligence, February 2, 1993, Reuters transcript.

The current challenge to defense intelligence officials, working with counterparts in the Central Intelligence Agency (CIA) and other national-level agencies, is to develop capabilities to support post-Cold War military operations while at the same time staying within reduced budgetary constraints.[2] The large number of potential intelligence targets precludes additional investment in satellites, fixed intercept sites, and numerous analytical centers that would replicate the systems once directed against the former Soviet Union.

Military commanders have always needed information about local conditions and enemy forces. They have historically depended upon long-range foot patrols, observer aircraft and ships, armed reconnaissance missions, forward observers, human agents, etc. Since World War II, such capabilities have dramatically expanded through technological innovations, including satellites which were extensively deployed in the 1970s and 1980s. Originally capable of photographing fixed installations and periodically returning canisters of exposed film to earth by parachute, satellites can now transmit streams of data directly, in real-time,[3] to lower-level commanders as well as intelligence agencies in Washington. Currently, Department of Defense (DOD) officials are attempting to tie the multiplicity of systems together in communications networks capable of transmitting voice, text, and imagery among different services and echelons of command. Theoretically simple, the process is proving difficult, time-consuming, and expensive.

An important aspect of this effort lies in taking advantage of advances in surveillance and communications equipment that can be deployed on short notice to support military operations (as well as inform senior decisionmakers). As reflected in the Desert Storm experience, modern information-gathering and communications technologies, aspects of what has been termed the information explosion on the battlefield,[4] have transformed military operations to permit relatively low-level commanders to use sophisticated intelligence effectively for

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[2]A complicating factor in attempting to describe the process in an unclassified paper is the fact that some equipment and missions that are closely linked to intelligence gathering are, for administrative reasons, not within the intelligence budget, nor are they overseen by either the Director of Central Intelligence or the two congressional intelligence committees. Within the intelligence budget, there are tactical and other intelligence related activities (TIARA) over which DOD officials have greater influence than over the National programs which directly support Washington-level policymaking. This paper looks at programs that, while related to intelligence gathering, are not limited to those that actually fall within the intelligence budget.

[3]"Real-time" is a term used to describe data which is transmitted instantaneously or nearly so as distinct from data collected, stored, and subsequently transmitted to users.

[4]See National Research Council, Board on Army Science and Technology, *STAR 21: Strategic Technologies for the Army of the Twenty-first Century* (Washington: National Academy Press, 1992), pp. 8, 104-105.

tactical operations. Better tactical intelligence will be necessary as warfare in the post-Cold War period may require commanders to display greater flexibility than was previously the case. This type of warfare will put a premium on rapid decision-making and judicious use of varied sources of intelligence. The importance of good tactical intelligence will derive in part from the use of precision guided munitions (PGMs) that must be provided extremely accurate target data. The need for accurate bomb damage assessment (BDA) to ensure that targets have been destroyed remains vital as an increasingly important goal is to avoid redundant and costly bombing campaigns.

During the Persian Gulf War, new capabilities for surveillance of enemy forces and territory were made dramatically apparent to commanders and to outside observers. U.S. and Allied commanders had far more detailed information on the enemy than ever before and the accumulation of detailed intelligence in a relatively short time span was a major contributing factor in the decisive victory over Iraq.

Reconnaissance aircraft were reportedly not available in sufficient quantities to satisfy all intelligence requirements. There were also other identified shortcomings. More importantly, a principal problem area revealed was the need for rapid communications capabilities to provide real-time transmission of imagery and other information to tactical commanders, between different echelons of command, and among the different services. Another shortcoming reflected in Desert Storm was the need for even more extensive overhead reconnaissance of areas of military interest. The limited number and high cost of satellites, the priorities assigned to their operation by national-level authorities, as well as their inherent limitations in observing cloud and smoke covered areas, have suggested that they alone will not meet all tactical capabilities sought for overhead surveillance.[5]

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[5]A 1992 review of future military requirements by a component of the National Research Council concluded: "The critical need is for a global, three-dimensional *terrain data base*. Querying and data retrieval must be easy and fast. Yet, quick updating of information must also be supported. Techniques are needed to give field commanders dynamic interrogation and viewing of local terrain, plus the ability to generate hard-copy opto-electronic storage media, a data base structure for storing three-dimensional data, software and hardware for rapid processing of large data sets, high-speed broadband communications links, multicolor map production from digitized data, microprocessor workstations as the local nodes in this terrain information network, and artificial intelligence to automate reasoning about the interaction of terrain features and other environmental factors, including the weather." *STAR 21*, p. 189.

A UAV SOLUTION?

Pilotless aircraft by definition include a variety of different craft, including target drones which serve testing and training purposes as well as cruise missiles which travel long distances to seek out their precise targets. For the purposes of this paper, however, UAVs are defined as aircraft carrying cameras or various types of surveillance equipment that fly over a target area and provide information to their home base either by returning with film or through direct transmission. UAV systems consist of the air vehicle, the payload, i.e., a camera, radar, or other device installed on the vehicle, data links, and ground stations for launch, recovery, and monitoring of transmitted data. Some UAVs operate on prearranged flightpaths; others can be controlled in mid-flight (these are known as Remotely Piloted Vehicles (RPVs)).[6] In many cases, payloads can be switched depending on the mission, allowing a single vehicle to be used for various missions. UAVs may be propeller driven or jet powered and are usually small, some being no more than six feet long.

Many observers, believing that technological innovation, a U.S. strength, offers effective solutions to the problem of increasing intelligence needs especially at tactical command levels,[7] have concluded that pilotless aircraft carrying sophisticated reconnaissance systems[8] will effectively supplement data provided by other collection systems. Currently planned UAV systems can be configured with various capabilities, including different types of radars, signals intelligence equipment, lasers, meteorological sensors, sensors to detect mines, chemical agents, and radioactivity. UAVs can, it is suggested, collect certain types of intelligence at lower costs and with advantages in cost, flexibility, and timeliness over satellites or other systems. UAV technology has been available for several decades, but, for a variety of reasons, UAVs have become an important part of intelligence operations only with the onset of the post-Cold War era.

Anecdotal evidence suggests that at times UAVs have suffered from having to compete with traditional manned platforms that have important

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[6]In this paper, the terms UAVs and RPVs are used interchangeably (as is the case in much of the open literature).

[7]Indeed, technical capabilities can serve to drive military requirements, at least to the extent that, if means exist to provide more information and reduce the risks of losses of human lives, there will be pressures to obtain them regardless of immediate budgetary considerations.

[8]Referred to in DOD publications as reconnaissance, surveillance and target acquisition (RSTA) or reconnaissance, intelligence, surveillance, and target acquisition (RISTA).

constituencies in the four services.[9] Much of the impetus for acquiring UAVs has come from Congress, which has prodded the Pentagon to consolidate its research and development (R&D) and procurement efforts. Despite such concerns and impending reductions in defense budgets, sustained spending for UAVs was endorsed in the Clinton Administration's FY1994 defense authorization request.[10]

Varying importance attached to UAVs is ultimately linked with the type of force structure that is to be maintained. UAVs can support military forces designed for limited or conventional warfare against enemies that (unlike the former Soviet Union) are not monitored on a constant basis by satellites and fixed, land-based surveillance stations. They are especially valuable for tactical reconnaissance and BDA of the immediate battlefield area. UAVs can be launched as needed by lower-level commanders, do not involve a danger of pilot losses, and can transmit real-time tactical data. To an extent, acquiring UAVs presupposes force structures and missions associated with operations in Third World areas and without extensive opportunity for preliminary planning. UAVs seem especially useful in "come-as-you-are" conflicts; they would be less important in maintaining static defensive positions or in engaging in strategic missile exchanges.

An advantage is that UAVs can provide intelligence data on short notice without interfering with the tasking of national collection systems. They offer certain advantages over satellites--they can fly close to the ground, under cloud cover, and on unpredictable schedules. Above all, they are comparatively inexpensive. On the other hand, UAVs also have disadvantages in comparison to satellites. They can be more easily attacked, they can spin out of control and crash, and they can be difficult to recover, especially onboard ships. They also have limited ranges and loiter times.

UAVs also have both advantages and disadvantages in comparison to manned reconnaissance aircraft. They do not put human pilots at risk of injury, capture, or death. UAVs are much less expensive, since they are smaller, lighter and have simpler design requirements. On the other hand, UAVs lack the flexibility of manned aircraft, they cannot be as easily or as unpredictably maneuvered. Manned aircraft currently have ranges and endurance rates that

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[9]See U.S. General Accounting Office, DOD's Use of Remotely Piloted Vehicle Technology Offers Opportunities for Saving Lives and Dollars, MASAD-81-20, April 3, 1981, especially p. 20. An analysis of the relationship between the culture of the services and preferred weapons systems is found in Carl H. Builder, *The Masks of War: American Military Styles in Strategy and Analysis* (Baltimore: Johns Hopkins University Press, 1989).

[10]Support for UAVs was reaffirmed in testimony before the House Armed Services Committee on May 6, 1993 by John M. Deutch, Under Secretary of Defense for Acquisition, who included UAVs among "silver bullet technologies" that can "radically improve our military capability." *Aerospace Daily*, May 7, 1993, p. 237.

are beyond those of UAVs. UAVs are more dependent on technologies which are not yet perfected. It is also likely that, as UAVs are used extensively, more effective countermeasures will be developed.

Future brigade-level intelligence efforts have been described by Army documents as based on all-source information "integrated into concise, objective, graphic portrayals of the current situation", with the primary tool used to "receive, correlate, and display this information . . . the Common Ground Station. . . ." The latter is a truck containing computer terminals displaying data transmitted from Joint Surveillance Target Attack Radar System (JSTARS) aircraft, other manned reconnaissance aircraft, a summary of intelligence from national-level sensors along with a UAV video display. The Army proposes a Military Intelligence Battalion for either a Light Infantry Division or an Armored Division with 24 UAVs, two or three launch/recovery units and three UAV common ground stations.[11]

EARLY HISTORY OF UAV USE

UAVs have been available since the era of World War I; target drones were used extensively both in the interwar period and during World War II.[12] It was, however, only during the Vietnam War that UAVs were extensively employed for surveillance purposes. From 1965-1972, UAVs were used to undertake surveillance missions over North Vietnam and other areas where manned reconnaissance flights had led to excessive personnel losses. During the course of American involvement in hostilities, some 20 versions of the Teledyne Ryan Firebee (BQM-34) flew over 3,400 missions providing coverage--photography and SIGINT (signals intelligence)--of China, North Vietnam, and other areas of the Far East that would present hazards to manned aircraft and at a time when satellites could not provide usable tactical intelligence to field commanders.

The Firebee, originally built in the early 1950s as a jet-powered target drone, was launched from manned aircraft, and could fly at altitudes up to 60,000 feet and was usually recovered by helicopters. Although a number of Firebees were shot down (with a few put on public display by China), the overall loss rate was about 4 percent. Unfortunately, in many cases, it proved impossible to identify which areas had been photographed and there were long

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[11]Robert E. Hallagan, "An Introduction to our Intelligence Branch Operational Concept," U.S. Army, Military Intelligence Professional Bulletin [*Military Intelligence*], January-March 1993, pp. 8-10. See also, "U.S. Army Demands Advanced UAVs To Support New Tactical Doctrines," *Aviation Week & Space Technology*, February 10, 1992, p. 51.

[12]For background on the development of UAVs, see Michael Armitage, *Unmanned Aircraft* (London: Brassey's Defence Publishers, 1988); Louis C. Gerken, *UAV--Unmanned Aerial Vehicles* (Chula Vista, CA: American Scientific Corp., 1991).

delays in developing the film, which was not made directly available to tactical commanders. Nonetheless, the UAV program was widely supported by military leaders who were concerned about the hostile air environment over North Vietnam and anxious about the high losses of pilots shot down by missiles and other means. In the early 1970s, UAVs were fitted with TV cameras which transmitted signals to an accompanying aircraft which provided guidance control. In this way more precise navigation was possible and the basis was laid for real-time observation of targets.[13] As one Defense Department official subsequently concluded: "The requirement for unmanned vehicles was there, but the technology was not yet adequate."[14]

During the post-Vietnam drawdown, UAV programs were transferred to the Air Force's Tactical Air Command which some critical observers believe has an institutional bias against unmanned aircraft. As a result of relatively poor reliability and difficulties in maintaining UAVs in the Defense Department's inventory, they were retired from active duty, put to use as targets, or stored. Satellite programs became the focus of attention of an Intelligence Community preoccupied with the dynamics of the U.S.-U.S.S.R. nuclear balance. Satellites could observe fixed targets, such as missile silos deep within the Eurasian landmass, and could not be neutralized with technology then available.

In the 1970s, the Army undertook one R&D program for a new UAV, based on the types used in Vietnam but with greatly enhanced capabilities. Code-named Aquila, the Lockheed Corporation program was eventually canceled because of technical difficulties, schedule delays, and mounting expenses. The basic air vehicles would have cost over $240,000 and the associated equipment would have brought the total to $1 million for each Aquila.[15] In essence, most observers believe that Aquila specifications became overly sophisticated, especially the requirement for a capability to designate targets with lasers for

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[13]See William Wagner, *Lightning Bugs and Other Reconnaissance Drones* (Fallbrook, CA: Armed Forces Journal International, 1982), pp. 196-197. Wagner's book contains an extended discussion of the use of UAVs in the Vietnam era. See also Robert B. Piper, "The Unmanned Air Reconnaissance System (UARS)," *Unmanned Systems*, Winter 1988-89.

[14]Statement of Donald Fredericksen, Deputy Under Secretary of Defense for Research and Engineering (Tactical Warfare Programs) in U.S. Congress, 99th Congress, 2d session, House of Representatives, Committee on Armed Services, Defense Department Authorization and Oversight Hearings on H.R. 4428 [H.A.S.C. No. 99-36] (Washington: Government Printing Office, 1987), p. 243.

[15]See ibid., p. 256.

artillery shells.[16] In all, some $1 billion was invested in the program before it was canceled under congressional pressure in 1987.

U.S. observers did take notice of the successful use of unmanned craft by the Israelis against Syrian targets in the early 1980s. During operations in the Bekaa Valley of Lebanon in 1982, Israelis were able to use their Mastiff and Scout UAVs (small propeller-driven UAVs with wingspans of some 4 meters) to pinpoint Syrian air defenses and missile batteries that were then neutralized with relative ease and without the loss of Israeli pilots.[17] This contrasted with the well-publicized shootdown in 1983 of American naval aviators flying targeting missions over Lebanon for the *USS New Jersey*.

As a result, then-Navy Secretary John Lehman moved decisively to acquire a UAV capability for the U.S. Navy. Lehman directed the purchase of several Israeli-manufactured Mastiff III UAVs in 1984 to serve as gunfire support for

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[16]One observer argued in 1986 that: "The problem was, and still is, the insistent requirement that each Aquila, on every mission, be able to perform the dual role of forward artillery observation and tactical laser designation. Aquila can certainly do one or the other, but given the present state of electronic, optical and laser micro-technology, it simply cannot do both in the existing airframe; and any increase in the size of the aircraft would have a geometric decrease in the Aquila's survivability." Don L. Harvey, "A Troubled Nest for Aquila," *NATO's Sixteen Nations*, April 1986, p. 76.

[17]According to one report, "Months before the attack, Israeli UAVs 'fingerprinted' Syrian surface-to-air radars by gathering the electronic frequencies of those radars and programming them into Israeli antiradiation missiles for use during an attack. When the attack came on 9 June, UAVs flew over the battlefield first, emitting dummy signals designed to make Syrian radar operators believe real Israeli aircraft were attacking. This tactic was effective in two ways. First, the Syrians launched most of their available surface-to-air missiles (SAM) against the UAVs. When the SAM batteries were in the midst of reloading, Israeli fighters attacked. Second, this deceptive tactic caused Syrian radars to actively track the UAVs, thus tipping off the Israelis to where the emitting radars were. Using the electronic frequency signature gathered earlier, Israeli fighters carrying antiradiation missiles closed in and, along with artillery fire, destroyed the SAMs.

The accuracy of the lethal artillery barrage was helped by UAVs performing a surveillance role. The flying vehicles transmitted real-time pictures of the Syrian SAM sites to Israeli commanders so they could assess the effectiveness of their artillery fire and adjust it accordingly. The Israeli Air Force also used UAVs in a surveillance role by positioning them over three major airfields deep within Syria to gather data on when and how may aircraft were taking off from Syrian airfields. . . ." Brian P. Tice, "Unmanned Aerial Vehicles: The Force Multiplier of the 1990s," *Airpower Journal*, Spring 1991, pp. 43-44.

battleships.[18] The Navy also initiated an expedited procurement program that resulted in the acquisition of Pioneer UAVs from the AAI Corporation of Baltimore, Maryland, in cooperation with Maslat Ltd., an Israeli firm. This procurement effort was based in large measure on current technology rather than on a new design utilizing research and development. The FY1986 $25.8 million contract was for three Pioneer systems (a system consists of ground control/monitoring stations and eight vehicles) with options for six more for an additional $61.9 million in FY1987 and FY1988. The system was equipped with a jam-resistant, two-way data link to provide real-time video imagery.[19] Eventually five systems have gone to the Navy, three to the Army and one to the Marine Corps. The Pioneer, which would subsequently see extensive use in Desert Storm, has a length of 4.2 meters and a wingspan of 5.2 meters, and is propeller-driven by a 26 horsepower engine. It has a range of 185 km and an endurance of 5-6 hours, flying at altitudes up to 15,000 feet. In the next few years, the Navy, Marine Corps and Army acquired additional Pioneers.[20]

Renewed interest in UAVs also emerged in other parts of the Pentagon. In 1984, the Defense Department's Defense Resources Board had tasked the Joint Chiefs of Staff (JCS) to review requirements for UAVs by the individual services. Primary requirements included survivable, easy to operate and low-cost systems with real-time data links. It was apparent that technological developments such as miniaturization of electronics, improvement of sensors, development of reliable and jam-resistant data links, and improvement of navigation accuracy could make it feasible to overcome the limitations of Vietnam-era systems.[21] Key differences existed in the individual service's requirements, however. This was especially so in regard to the Navy's needs for shipboard recoverability that was more risky and complicated than recovery on a runway. As a result of this study, eventually approved by the Secretary of Defense, the Reagan Administration's FY1987 budget submission included renewed UAV procurement. As noted below, pp. 13-18, Congress supported acquisition of UAVs, but only in the context of a DOD-wide effort.

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[18]Subsequently, Mastiffs were transferred to the Marines, providing "for the first time company and battalion commanders . . . [with] real time sensor intelligence organic to the division." Statement of Rear Admiral Stan Arthur, Defense Department Authorization and Oversight Hearings on H.R. 4428 [H.A.S.C. No. 99-36], p. 253.

[19]Glenn W. Goodman, Jr., "U.S. Military RPV Programs Have Taken Big Strides in 1986," *Armed Forces Journal International*, December 1986, p. 66.

[20]RPVs have also been used on a trial basis in drug interdiction efforts, flying along the U.S./Mexico border. See "UAVs Soar into the Drug War," *Armed Forces Journal International*, July 1990, p. 47.

[21]Defense Department Authorization and Oversight Hearings on H.R. 4428 [H.A.S.C. No. 99-36], p. 243.

UAVs IN THE PERSIAN GULF WAR

In the Persian Gulf War, U.S. forces made extensive and unanticipated use of UAVs. There was a need for accurate and extensive information on the strength and disposition of Iraqi forces within time constraints that could not be met by other systems, including satellites. The Navy used Pioneers launched from battleships to support shore bombardment operations with fire direction and spotting; the Army and Marines used UAVs for target designation, damage assessment, and reconnaissance and warning.[22] The Marines faced an especially serious tactical intelligence shortfall as their RF-4b had recently been taken out of service and had not yet been replaced.

As described in one account:

> UAVs were used to map Iraqi minefields and bunkers, thus allowing the Marines to slip through and around these defenses in darkness, capture key command sites without warning and speed the advance into Kuwait City by as much as two days.

During the attack on the Iraqi-held Kuwait International Airport:

> a live Pioneer RPV picture, showed a battalion of Iraqi tanks poised on the north end of the airfield for a counterattack. The armored force was broken up by naval gunfire and air attacks before it could strike the advancing Marines . . . .[23]

The Commander of the Second Marine Division during Desert Storm, Lt. Gen. William M. Keys, judged that:

> The RPV worked very well, but we needed many more of them, plus systems to disseminate their information to all units that needed it. In my opinion, the RPV is going to be our best tactical intelligence-gathering vehicle in the future, and we need to develop that program.[24]

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[22]The Army and Air Force also used UAVs in missions not properly described as intelligence related to deceive, confuse and saturate Iraqi air defenses. See "US UAV Programmes: Where Do We Stand?," *Military Technology*, October 1991, p. 19. In some cases, UAVs were used to confirm ground targets first identified by JSTARS aircraft. U.S. Department of Defense, [UAV Joint Program Office], Unmanned Aerial Vehicles (UAV) Master Plan, 1992 (Arlington, VA: Joint Project Office, 1992), p. 60.

[23]David A. Fulghum, "UAVs Pressed Into Action To Fill Intelligence Void," *Aviation Week & Space Technology*, August 19, 1991, p. 59.

[24]"Rolling with the 2d Marine Division," *U.S. Naval Institute Proceedings*, November 1991, p. 80.

The Defense Department's Desert Storm Final Report noted that: "During one mission, a Pioneer located three Iraqi artillery battalions, three free-rocket-over-ground launch sites, and an antitank battalion." It concluded that Pioneers "proved excellent at providing an immediately responsive intelligence collection capability."[25]

UAVs served to supplement intelligence collection by reconnaissance aircraft and satellites and indeed provided detailed bomb damage assessment of tanks and other vehicles that satellites and aircraft could not have acquired. The new JSTARS aircraft successfully provided real-time data on Iraqi ground forces. Other reconnaissance aircraft, carrying various sensors, operated from bases in Saudi Arabia and elsewhere in the region. Satellites were used in innovative ways in Desert Storm to support lower-level field commanders. Nevertheless, there were limitations to the coverage given the numbers of satellites then deployed (which could not be drastically augmented within a few months).[26]

As one non-government observer has concluded based on interviews with intelligence analysts:

> The US also lacked the ability to scan more than a portion of the battlefield at any one time . . . . The lack of broad, synoptic, or near-simultaneous coverage made it difficult to fix the table of organization of some Iraqi units, led to an overestimation of Iraqi troop numbers, and contributed to the allied inability to completely eliminate the mobile Scuds . . . .[27]

The Gulf War demonstrated the effect of computerized technology on post-Cold War military operations. Although there were significant shortcomings, lower-level commanders now have the technical capability to obtain and utilize intelligence from a variety of sources, both those under their own control as well as systems controlled at the theater and national levels. The amount of photography and other forms of imagery (e.g., from overhead radar and infrared systems) and signals intelligence enables commanders to plan and conduct operations with a better understanding of the enemy's capabilities and force dispositions. The Desert Storm experience demonstrated that improved intelligence, combined with precision-guided munitions, makes it possible to conduct air campaigns (and shore bombardment) with far greater accuracy than

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[25]U.S. Department of Defense, Conduct of the Persian Gulf War: Final Report to Congress, April 1992, Appendix C, p. 12.

[26]See Marcia S. Smith, Military and Civilian Satellites in Support of Allied Forces in the Persian Gulf War, CRS Report 91-215SPR, February 27, 1991, especially p. 9.

[27]Jeffrey T. Richelson, "Volume of Data Cripples Tactical Intelligence System," *Armed Forces Journal International*, June 1992, p. 36.

has been possible in the past. Ground operations can be conducted with improved confidence and opportunities for victory and with lower casualty rates.

Some of the advantageous conditions prevailing in Desert Storm will probably not be present in the future. Many countries are undoubtedly working on countermeasures to U.S. intelligence systems, including UAVs, and future enemies will seek to neutralize the technological superiority recently demonstrated by the United States. Such antagonists will, in addition, make use of intelligence and communications technology that is to a large extent commercially available throughout the world.

CONGRESS AND UAVS; CURRENT R&D AND PROCUREMENT

The role of Congress in encouraging the acquisition of UAVs differs from the usual pattern in which a service initiates new technologies and seeks congressional authorization and appropriations. UAVs have never had pervasive and determined support by any service, but armed services and appropriations committees in both houses have sought to encourage the procurement of UAVs because of their comparatively low cost and their utility to military operations and to do so in a way that would avoid unnecessary duplication among any UAV programs that might be initiated.

As a result of growing concerns about the high costs of the ill-fated Aquila project in the mid-1980s, Congress had taken a close look at efforts to provide UAVs when the Reagan Administration proposed renewed acquisition in FY1987. There was particular concern about the possibility of single-service efforts that might duplicate programs underway elsewhere in DOD. Congress elected to establish a DOD-wide program which could be closely supervised by the civilian-led Office of the Secretary of Defense (OSD). The Continuing Appropriations Act for FY1988 (P.L. 100-202) provided that funds for UAVs not be obligated or expended until DOD submitted to Congress a Master Plan explaining which UAVs would be supported with the available funds, and assessing the cooperation by the military services with efforts to coordinate UAV programs and to eliminate duplication.

A UAV Executive Committee was formed to oversee the UAV effort in April 1988 and the JPO was established, with the Naval Air Systems Command as executive agent for DOD. Beginning in 1988, the JPO has issued a series of UAV Master Plans laying out the main goals of the program.[28] The FY1988 Defense Authorization Act (P.L. 100-180) authorized funding for the development of UAVs in a Defense Agencies account instead of separate service

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[28]The plans were published by the JPO; a review of the initial version is U.S. General Accounting Office, "Unmanned Vehicles: Assessment of DOD's Unmanned Aerial Vehicle Master Plan," Report No. GAO/NSIAD-89-41BR, December 1988.

accounts, and separate service program elements for UAVs were eliminated.[29] The goal was to procure systems, using as much off-the-shelf, commercially available technology as possible that could be used by all the services. It was envisioned that different payloads would be installed on the vehicles for different missions.

Procuring such systems in a Defense Agencies account, rather than in one of the service's accounts, was unusual and faced some internal DOD opposition. When the separate line item for UAV procurement was formally questioned by Pentagon officials, the conference report for the FY1991 Defense Appropriations Act noted:

> In establishing OSD managed research and development and procurement funding lines in fiscal year 1988 for the UAV Joint Projects Office, the intent of Congress could not have been made more clear. All funds appropriated for the UAV Joint Projects Office shall remain under their administrative control for obligation and execution. Attempts to resource UAV programs in unique service budget accounts [run] counter to congressional guidance and direction concerning the consolidation of all service UAV programs in the Joint Project Office. The conferees therefore direct that all funding for UAVs be maintained in the current Defense Agency accounts.[30]

Most RDT&E and procurement of UAVs still remain in Defense Agencies accounts (under Program Element 0305141D) while some RDT&E as well as operations and maintenance, military personnel, and military construction expenditures are funded through the services.

In the years since 1988, Congress has strongly supported UAVs, providing on several occasions greater funding than requested by the Bush Administration. The House and Senate have continued to express their determination that UAV development remain a joint effort, rather than devolving to the individual

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[29]U.S. Congress, 100th Congress, 1st session, Committee of Conference, National Defense Authorization Act for Fiscal Years 1988 and 1989, House Report No. 100-446, (Washington: Government Printing Office, 1987), p. 575.

[30]U.S. Congress, 101st Congress, 2d session, Committee of Conference, Conference Report to Accompany H.R. 5803, House Report No. 101-938 (Washington: Government Printing Office, 1990), p. 95.

services. The goal, reiterated in report language, has been to develop UAV systems for the services that have as many features in common as possible.[31]

Unfortunately UAVs have not been arriving and frustration has been expressed at the apparent slow progress of UAV programs. One writer has suggested that "in the minds of some high-level bureaucrats the UAV JPO has become too much of an R&D stronghold and has, on occasion, tailored technology development without consulting the services except superficially."[32] In 1991, the Senate Appropriations Committee expressed its concern that the JPO "has failed to allocate sufficient funds in its annual budget request and spending plans for desired activities." Further, the committee expressed its concern "about undue delays in fielding UAV systems which meet joint requirements. The prospect of inappropriately long RDT&E activities would deny useful capabilities to our Armed Forces."[33] Similarly, the House Appropriations Committee noted:

> with displeasure, that despite . . . the appropriation of $350 million in R&D funding since 1988, the JPO has yet to produce a single UAV system. The Committee further notes that the Pioneer and Pointer systems used during Operation Desert Storm were in existence well before the establishment of the JPO. In addition, the Committee sees a UAV requirements process that is clearly broken . . . .[34]

In 1992 the conference committee considering the Defense Authorization bill expressed

> serious reservations over the management of these [UAV] programs by the joint project office. Remarkably little progress has been registered during the past five years in this area. The conferees believe the

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[31]For example, in 1992, the House Committee on Armed Services noted: "The committee continues to believe that the UAV program must continue to place a high priority on commonality and on interoperability across all UAV systems, particularly with respect to payloads, data links, software, ground stations and recovery systems." U.S. Congress, 102d Congress, 2d session, House of Representatives, Committee on Armed Services, National Defense Authorization Act for Fiscal Year 1993, House Report No. 102-527 (Washington: Government Printing Office, 1992), p. 162.

[32]"US UAV Programmes: Where Do We Stand?," *Military Technology*, October 1991, p. 20.

[33]U.S. Congress, 102d Congress, 1st session, Senate, Committee on Appropriations, Department of Defense Appropriation Bill, 1992, Report No. 102-154 (Washington: Government Printing Office, 1991), p. 334.

[34]U.S. Congress, 102d Congress, 1st session, House of Representatives, Committee on Appropriations, Department of Defense Appropriations Bill, 1992, Report No. 102-95 (Washington: Government Printing Office, 1991), p. 214.

Secretary of Defense should undertake a comprehensive review of the joint [project] office.[35]

[35]U.S. Congress, 102d Congress, 2d session, Committee of Conference, National Defense Authorization Act for Fiscal Year 1993, House Rept. 102-966 (Washington: Government Printing Office, 1992), p. 635.

Appropriations for Research, Development, Testing & Evaluation (RDT&E) for Joint UAV Program

(In thousands of dollars)

Fiscal Year	Budget Request	House Approved	Senate Approved	Conference Approved
FY1988	-	-	50,291	50,291
FY1989	34,766	34,766	-	40,916
FY1990	117,005	117,005	62,669	82,304
FY1991	82,099	92,099	67,099	92,099
FY1992	68,562	86,300	70,513	104,213
FY1993	129,059	147,059	139,259	139,259
FY1994	187,500			

(Note: In all cases, the amounts approved by the Conference Committees were subsequently enacted.)

Appropriations for UAV Procurement, FY1988-94

(In thousands of dollars)

Fiscal Year	Amount Requested	House Approved	Senate Approved	Conference Approved
FY1988	-	45,400	-	45,400
FY1989	65,600	-	0	50,600
FY1990	29,304	29,304-	29,304	29,304
FY1991	24,322	24,322	24,322	24,322
FY1992	138,370	138,370	138,370	138,370
FY1993	148,952	29,952	138,952	138,952
FY1994	69,300			

(Note: In all cases, the amounts approved by the Conference Committees were subsequently enacted.)

Congressional support for UAVs continues. In 1992, Congress authorized and appropriated some $278 million for procurement and R&D for FY1993. This figure included some $10 million to ensure that Pioneer systems are available until the new short range systems can be deployed. The final figure resulted after extensive discussions among Senate and House appropriations conferees as the House had originally preferred a lower figure and questioned the "premature" procurement of the new short-range system.[36]

The Clinton Administration, in its first DOD budget submission to Congress, proposed an FY1994 UAV acquisition program costing some $256.8 million, a reduction of $11.1 million from FY1993, but with an increase in RDT&E of $56.7 million indicating the continuing emphasis on future acquisition.[37] Negotiations underway in July 1993 over the future size of the Defense budget may, however, affect these plans.[38]

CURRENT UAV PROGRAMS

The Joint UAV Office has divided its efforts into several categories, *viz.*, short range systems, close range systems, and medium range systems. High altitude systems were once included in JPO planning, but have been dropped.[39] The several UAV categories are designed to be used by different echelons and can be equipped with appropriate sensors for specific missions.

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[36]U.S. Congress, House of Representatives, Committee on Appropriations, 102d Congress, 2d session, Department of Defense Appropriations Bill, 1993, Report 102-627 (Washington: Government Printing Office, 1992), pp. 148-149.

[37]U.S. Department of Defense, Unmanned Aerial Vehicles (UAV) Master Plan, 1993 (Arlington, VA: Joint Project Office, 1993), p. 81.

[38]See Joseph Lovece, "US Military Services Finally Embrace UAVs--Just as Procurement Funds Dwindle," *Armed Forces Journal International*, July 1993, pp. 21-23.

[39]Systems that can operate in the upper atmosphere and loiter for up to 36 hours have been classified as high altitude endurance systems. They could be used for wide-area surveillance using SIGINT and other sensors. Although there appear to be no current DOD requirements for high altitude systems, others in the Federal Government see a use for them in observing meteorological trends, including ozone depletion. One platform, the Condor, was built by the Boeing Corporation as a prototype, but failed to win support within a shrinking DOD. Some $5 million was included in the FY1994 Defense Appropriation Act to store the Condor and directed that an assessment be made regarding the feasibility of utilizing the aircraft in environmental research. See Warren E. Leary, "Scientists Try to Save Plane Pentagon Wants to Destroy," *New York Times*, March 7, 1993, p. A20.

CLOSE RANGE (CR) UAV SYSTEMS

Systems that can operate out to 30 km and operate for up to three hours are classified as close range systems. They are designed to be transportable by two persons. They would be used by Army and Marine Corps divisions and division elements. As a result of low cost, they could be fielded in relatively large numbers. They are man-portable and their use requires relatively little maintenance and training. The Pointer system used by the Marine Corps during the Persian Gulf War proved to be a disappointment in that it was unable to fly in winds of more than 15 knots and to operate out of visual range in the desert.[40] The JPO has funded close range UAV advanced technology demonstrations by six different manufacturers and plans to award a procurement contract in FY1994.

SHORT RANGE (SR) UAV SYSTEMS

Short range systems operate out to 150 km and support Army divisions and higher echelons and Marine expeditionary brigades. Pioneers were the UAVs most often employed in the Persian Gulf War and acquiring an upgraded version is the current focus of JPO procurement efforts; it is intended that other systems will utilize SR components. They operate at low altitudes (1,000 to 12,000 feet) in enemy rear areas, providing near-real-time imagery or other data regarding enemy activities. The Director of the Joint Program Office, Rear Admiral George Wagner, has indicated that getting the short range UAV system into low-rate production is his office's primary UAV priority.[41]

The Pioneer UAVs operated by the Marine Corps, Army, and Navy were used extensively in the Persian Gulf War. Based on an Israeli design, the Pioneers, produced by the AAI Corporation, a U.S. firm were acquired by the Navy in 1986. The Pioneer can be equipped with a TV camera and forward-looking infrared sensors. Pioneers have a length of 4.2 meters and a wingspan of 5.2 meters and are powered by a 2-horsepower propeller engine.

Although the Pioneers proved their value in Desert Storm, there were complaints that they were too few in number and required overly cumbersome ground support equipment--generators, aviation gasoline (which is not usually available on non aircraft-capable ships and at Army ground sites) and paved runways of some 250 meters. Their range and communications capabilities were also limiting factors. More important is the need to improve the ability to manage, analyze, and communicate data collected by UAVs.[42]

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[40]See David A. Fulghum, "UAVs Pressed in Action to Fill Intelligence Void," *Aviation Week and Space Technology*, August 19, 1991, p. 59.

[41]*Defense News*, December 21-27, 1992, p. 22.

[42]See "Gulf War Prompts Improvements in Next Generation of UAVs," *Aviation Week & Space Technology*, December 9, 1991, p. 44.

The new short range system, designed to replace the Pioneer, is the Hunter, produced by TRW along with an Israeli firm. The Hunter has a wingspan of nearly 30 feet and can carry a sensor package of up to 200 pounds and a flight duration of more than eight hours. Acquisition of an upgrade of the Pioneer began in FY1989 and two firms produced models. Although the General Accounting Office criticized DOD for planning "to start [short range UAV] production based on limited testing that did not adequately address several critical system performance capabilities,"[43] the Hunter was selected for further testing in late 1992. On February 19, 1993 the Under Secretary of Defense for Acquisition, Donald J. Yockey, certified the approval by the Defense Acquisition Board of seven of the short range systems for system qualification and operational testing, with full-rate production of some 48 systems to follow after a review in the spring of 1995. It is anticipated that during FY1995 Army and Marine Corps Pioneers will be transferred to the Navy as the Hunter becomes available.[44]

At the same time, additional procurement of 12 Pioneers and spare parts are being made to replace those lost in the Persian Gulf War. These units will reportedly be improved versions with additional engine fuel capacity and upgraded payloads.

MEDIUM RANGE UAV SYSTEMS

Systems that can operate out to 650 km are classified as medium range systems. Medium range UAVs could undertake pre- and post-strike reconnaissance in support of strike operations by manned aircraft and are under consideration by the Navy, Air Force, and Marine Corps. The primary sensor was expected to be eventually the Advanced Tactical Air Reconnaissance System (ATARS), a package of electro-optical sensors designed for manned aircraft as well as UAVs. In June 1993, however, the Air Force announced that work on ATARS was being halted and other sensors will have to be obtained for medium range UAVs.

Planning for a medium range UAV capability began in 1985 with the Navy responsible for the vehicle and the Air Force for developing electro-optical imagery sensors. In 1989 a contract was awarded to Teledyne Ryan for engineering and manufacturing development of a medium range system, designated BQM-145A, and in 1992 flight tests (one of which resulted in a crash shortly after takeoff) were conducted and a ground launch demonstrated in February 1993. The lengthy procurement process for the medium range system

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[43]U.S. General Accounting Office, "Unmanned Aerial Vehicles: More Testing Needed Before Production of Short-Range System," GAO/NSIAD-92-311, September 1992, p. 5.

[44]U.S. Department of Defense, Unmanned Aerial Vehicles (UAV) Master Plan, 1993, p. 36.

has been the source of congressional concern. In May 1991, the House Armed Services Committee noted:

> . . . due to inept management of the [Medium Range UAV (MRUAV)] program by the Navy, insufficient coordination between the Navy Program manager of the MRUAV vehicle and the Air Force Program Manager for the ATARS sensor system, and inadequate oversight by the Under Secretary of Defense for Acquisition, this critical program is being restructured, with the attendant cost increase and schedule delays. The issues that drive the restructure of the program are separation from the F/A-18, at-sea recovery, and the structure of the air-frame. All are Navy issues that should have been identified by Navy personnel during the Navy acquisition process before contract award, not two years later.[45]

Despite this history, medium range UAVs remain a major goal of the JPO and additional testing is currently planned although budgetary considerations and the cancellation of ATARS procurement may jeopardize the program. These 18-foot long, jet powered vehicles were estimated in 1991 to cost some $1 million each.[46]

NAVAL SYSTEMS

Admiral Wagner, the head of the JPO, made the case for maritime UAVs in straightforward language:

> We have a manned helicopter capability on many of our surface combatants right now; I think there is a role for unmanned systems wherein we won't always have to send in a manned helo. If we assume the next conflict is less likely to be world conflict than a Third World regional conflict such as what we saw in Southwest Asia, it can be expected to be fought closer to the coast. You will want to see what is going on over the hills inside the country; you will want to go out and detect without putting a man at risk in a manned aircraft. This is a perfect application for a "small boy," where hundreds of miles of coastline can be covered by a string of destroyers, frigates or other surface combatants--just keep good surveillance and determine what's going on in the region. One of the disappointments of Southwest Asia was in battle damage assessment. UAVs could have played a big role

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[45]U.S. Congress, 102d Congress, 1st session, House of Representatives, Committee on Armed Services, National Defense Authorization Act for Fiscal Years 1992 and 1993, Report No. 102-60 (Washington: Government Printing Office, 1991), p. 178.

[46]See "Medium-Range UAV to Help Military Narrow Tactical Intelligence Gap," *Aviation Week and Space Technology*, December 9, 1991, pp. 42-43.

> in helping close the gap in feedback, of success or failure of attacks, enabling better concentration of resources. . . .[47]

Despite this experience, one senior admiral candidly acknowledged that "It is a crime that the U.S. Navy ends up in 1992 without a single remotely piloted vehicle in the fleet."[48] The absence of naval UAVs in large measure results from difficulties in launching and recovering UAVs from shipboard that present unique obstacles to the use of UAVs by the Navy. Provisions were made for launching and retrieving UAVs from battleships which launched Pioneer UAVs during the Persian Gulf War. Although the battleships were subsequently retired from the active list, flat-decked amphibious ships are being configured for UAV take-offs and landings.

Extensive consideration has been given to UAVs capable of vertical take offs and landings. In a written response to the Senate Appropriations Committee in 1992, the Navy indicated that it had a program to:

> demonstrate the tactical utility of ship based VTOL [vertical take-off and landing] UAVs for: ship self defense against near surface and floating mines; OTH RISTA [over-the-horizon reconnaissance, intelligence, surveillance, and target acquisition] of inshore areas to detect and geolocate mines for future MCM [mine countermeasure] operations; OTH RSTA of operating and transit areas to detect mine laying and clearance operations; and surveillance of swept areas to detect reseeding operations.[49]

For FY1993, Congress authorized $15 million for VTOL UAV testing, emphasizing the need to maximize commonality with other systems.[50] Plans for testing the Maritime Vertical Takeoff and Landing Unmanned System (MAVUS) are underway. The MAVUS tests will be conducted with Canadian cooperation as the system is based on CL-227 Sentinel UAV developed by Canadair, Inc. of Canada. A tilt wing/rotor vehicle is also under consideration.

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[47]Interview with Rear Admiral George F.A. Wagner: "UAVs: A Growth Industry," *Unmanned Systems*, Summer 1992, p. 7.

[48]Vice Admiral William Owens, Deputy Chief of Naval Operations for Resources, Warfare Requirements and Assessment, April 7, 1993, quoted by *Defense News*, April 19-25, 1993, p. 22.

[49]U.S. Congress, 102d Congress, 2d session, Senate, Committee on Appropriations, Department of Defense Appropriations for Fiscal Year 1993, Hearing 102-638, Part 4 (Washington: Government Printing Office, 1993), p. 90.

[50]See U.S. Congress, 102d Congress, 2d session, House of Representatives, Committee on Armed Services, National Defense Authorization Act for Fiscal Year 1993, Report No. 102-527 (Washington: Government Printing Office, 1992), p. 162.

CIVILIAN APPLICATIONS

UAVs have not been deployed extensively for non-military purposes, most of which involve no substantial threat to a human pilot. Several agencies have experimented with UAVs in counternarcotics operations with successful results. Additional proposals include use for aerial surveying of forests, highways, environmental conditions, and other concerns. Possible non-governmental uses are real estate surveying, checking on crops and cattle, security surveillance, lumber spotting, monitoring oil pipelines, etc. Some observers believe, however, that the civilian UAV industry will ultimately develop as a result of the development of military technology since the current uses for UAVs have not yet led to widespread purchase of UAV systems by the private sector. In 1992 the Federal Aviation Administration began a process to establish rules governing the operation and flight of UAVs in civilian airspace in the U.S.

ISSUES FOR CONGRESS

Congress played a major role in focusing the attention of the Defense Department on the potential of UAVs with special attention on the importance of taking advantage of civilian technology as well as interoperability and commonality of the UAV systems acquired by the different services. The creation of the Joint Project Office and the provision of funding through Defense Agencies accounts have reflected congressional determination to treat UAV acquisition in a manner different from most DOD programs. Congress has also at times provided funding for UAV programs beyond that requested by previous administrations.

Future defense budgets are expected to be tightly constrained. Along with most other DOD programs, UAVs will be subject to great scrutiny and perhaps greater competition from other projects of interest to the services and the Intelligence Community. Congress will undoubtedly seek to monitor developments in UAV procurement closely while weighing the relative costs and benefits in the determination of future budgetary priorities.

CONCLUSION

UAV programs represent the confluence of several trends, *viz.* new intelligence-gathering and communications technologies, new requirements for military capabilities in the post-Cold War world, and congressional support of joint procurement efforts. UAVs have been available for decades, but the availability of new technologies have given them new attractiveness in the Defense Department. The R&D and procurement efforts have, however, moved slowly. It is evident that the need for UAVs is widely recognized, but they continue not to receive the emphasis given to programs that the services consider more central to their missions. UAVs have benefitted from the emphasis placed on them by Congress and the focused attention of the Joint Program Office.

The Desert Storm experience persuaded many defense experts that the U.S. ability to gather and communicate intelligence data directly to tactical commanders will have an important influence on the future conduct of military operations. This ability, in the eyes of some, can provide an important advantage with reduced casualties that will allow the U.S. to enhance its combat capabilities while reducing defense spending.

The end of the Cold War provides an uncertain future for the U.S. military. Forces required for potential NATO-Warsaw Pact struggle in Central Europe appear likely to be replaced by capabilities to protect U.S. interests in limited conflicts in Third World areas. Essential elements will include flexibility, adaptability, and maneuverability. Intelligence support may not include expensive, dedicated facilities that were constructed to monitor Warsaw Pact capabilities and intentions.

Congress has, for many years, been concerned with the problems of waste and duplication of effort in the defense budget. It has proven administratively difficult to persuade or compel the service s to merge their R&D and procurement efforts.