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UNMANNED AERIAL SYSTEMS USED IN THE ARMIES OF DEVELOPED COUNTRIES

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Abstract: *The article deals with the issue of unmanned aerial systems used in the armies of developed countries. Air forces of modern armies nowadays are equipped with powerful aerial technologies with many combat possibilities of fulfilling a large spectrum of tasks. On the other hand, piloted combat aircrafts represent very expensive and complex weapon systems dependent on airports and the corresponding infrastructure. The development of combat options of modern means of anti-air defence, which can be part of the armament of the potential enemy, represents a bigger threat not just for the combat aircraft, but fore mostly for the crew. Thus it is natural, that new ways and means of eliminating risks are being searched for. One of the ways is the usage of unmanned aerial systems, which moreover save finances.*

Keywords: *unmanned aerial systems, UAV, aircrafts, aerial technologies, Air Force*

INTRODUCTION

Unmanned aerial vehicles (UAVs) are not new, they have a long history in aviation. UAV missions flew mainly to cover areas determined too hazardous for manned reconnaissance aircraft. Additionally, these missions occurred at a fraction of the cost of and risk to manned aircraft. UAVs will play a significant role in future operations. UAV technology can not replace the human operator, but it will increase the requirements for skilled airmen. The UAV debate was born in World War I but new technology has recently nurtured the argument. World War I introduced the airplane, manned and unmanned, to the world as a military technology. Manned aircraft were capable of numerous combat duties and became a glamorous weapon of war. Unmanned aircraft were experimental, never achieved any measure of success, and thus were always behind the scenes.

Current international agreements prohibit space based weapons and our information metasystem is only a concept, so this essay will focus specifically on the UAV issue and explore the possibility that airmen will be replaced by unmanned vehicles in the nearest future.

The Air Force is now envisioning other potential missions for UAVs beyond the traditional reconnaissance mission. Also, Micro UAVs (Fig. 1), less than 15 cm long, could provide the basis for even more potential applications.

Fig.1 AeroVironment, USA

Increased sensitivity to risking human life in combat is pushing the Forces towards expanding UAV applications. Also, the rapidly advancing technologies are pulling us towards the economic viability of expanding the role of UAVs in the future force structure. As the USA military evolves to become a more flexible force across the spectrum of conflict, clearly UAVs will be an integral part of thier ability to meet the challenges of the 21st century.

1 UNMANNED AERIAL COMBAT VEHICLES

In 1982, the Israeli Air Force overran Syrian defences in the Bekaa Valley and destroyed the Syrian Air Force in one of the largest air battles since WWII. Key to that victory was small unmanned aircraft used to deceive and destroy the Syrian integrated air defence system. This incident focused world wide military attention on the UAV issue. The principal argument for UAVs is that they save lives.

Weapons and equipment that face destruction at the enemy's hand should be unmanned. Unmanned aircraft could be used in any situation. They could fly into extensive defence networks, with no regard for human life.

The Gulf War laid this foundation and set the standard for modern combat operations. The expectations produced by these operations may be unrealistic. While low casualties are desirable, the expectation that losses will be minimal on a fluid battlefield may inhibit the future use of force as an instrument of national power.

The importance of saving human life has become critical to the success of, for example, USA military operations. In August of 1995, a Predator UAV was completing a reconnaissance mission in Bosnia when it was shot down. The Predator served as a loyal soldier and hardly a mention of its shoot down was noticeable in the world press. There may be a greatly added political benefit to this life saving drone aircraft. When they are shot down or fall from the sky they have little impact on the world's political fabric.

Taking the human being out of the aircraft allows a significant reduction in developmental and operational costs. When aircraft were first developed little thought was given to what is now called the pilot-vehicle-interface. In today's complex and demanding environment, cockpit design and pilot life support systems consume a considerable amount of total resources available. It will cost approximately \$17 billion to design and implement the F-22's advanced pilot-vehicle-interface. Almost 30 percent of the total F-22 program cost is invested in the pilot alone. Operational costs may go much higher. The cost of flight training for a single USA fighter pilot is now estimated at \$2 million. That's just initial training cost. The maintenance cost of two thousand actively flying F-16 pilots is close to \$1 billion per year. [2] Removing the human operator results in a significant dollar savings and consumes less design resources. Time in development is also reduced as an expensive interface becomes unnecessary.

Eliminating the cockpit, life support systems, and pilot leads to another great advantage: size and weight reduction. Aircraft performance is severely limited by aircraft size and weight. Removing the pilot and his or her supporting architecture produces a corresponding increase in aircraft performance. Also, the unmanned aircraft will not be limited by the physiological barriers that nature has placed upon the pilot.

Endurance becomes limited only by fuel supply, not the pilot's bladder, physical comfort or exhaustion level. Regardless of the altitude, a UAV will not require oxygen or expensive pressure suit equipment.

This experimental UAV is capable of achieving acceleration levels that would kill the human pilot. The UAV with reduced size and increased performance will also have a corresponding reduction in signature and thus is more survivable. Saving lives, reducing cost, and improving performance are strong motives for removing the human from the cockpit.

The most successful UAV to date has been the cruise missile. The cruise missile is nothing more than an unmanned aircraft on a one-way mission (Fig.2). The cruise missile has its origins in WWI and WWII. During WWI an unmanned aircraft carrying an explosive device was designed. The device was launched from a track and was set to fall on its target after flying a specific heading for a specific amount of time. The device provided all the benefits of UAVs: its use did not threaten the life of a pilot; when they were dying at an unprecedented rate, and the cost was low at four hundred dollars to put three hundred pounds of explosive over a target.

Fig.2 Submarine-launched Tomahawk cruise missile

The cruise missile relies on an inertial navigation system upgraded throughout the flight by comparing memorized topographical maps with actual areas of the earth's surface and recently improved with Global Positioning System updates.

Like the cruise missile, for example the Predator UAV has been combat tested in 1996. The Predator is capable of flying at twenty-five thousand feet for up to 50-hours.

Fig.3 General Atomics AS, USA

The Predator is remotely controlled and relays its video, radar, infrared or elint information to a line-of-sight ground station or to overhead satellites. The Predator embodies all the benefits of the UAV: it eliminates the need for humans to perform high risk or mundane intelligence gathering missions, it is relatively inexpensive, and the aircraft can far outperform any human with its 50-hour endurance.

The benefits of UAVs are highly desirable and as the preceding examples show, have already been effectively demonstrated. If lives and money can be saved, with a corresponding increase in mission effectiveness, unmanned vehicles will become an essential warfighting tool. In regard to these issues, UAVs will greatly serve the national interest.

2 THE FUTURE OF UAV

The computational power of computers is multiplied 4,000 times every decade and by 2015 10 gigabytes of memory will fit on a crystal smaller than a sugar cube. Several

USA experts predict that autonomous weapons using artificial intelligence supported by automatic target recognition algorithms employing multispectral sensors will rule the battlespace. They predict that in the next 20 years data fusion rates will be 10,000 times faster and more accurate than they are now and data storage capabilities will be at least 1,000 times greater. These capabilities are predicted to produce computers that mimic thought and maybe even think for themselves with some level of self awareness. This increase in computational power may provide the human qualities of flexibility and adaptability to all types of UAVs.

There are two categories of unmanned aircraft: Man-in-the-loop (MITL) and autonomous. MITL systems have some type of human operational interface. The aircraft is airborne and humans control it from the ground. Predator is an example of this UAV category. On the other hand, autonomous systems takeoff and fly with no human interaction. Autonomous UAVs are further subdivided into programmable or independent systems.

Programmable systems fly a pre-planned profile based on a preset software program. Truly autonomous (independent) platforms make the decisions required to complete their mission. DarkStar and the cruise missile are autonomous UAVs. Both types of UAVs offer unique benefits and have unique support requirements. MITL systems currently offer a greater degree of adaptability as mid-mission inputs allow course, altitude, and/or target flexibility. MITL systems use data-link to communicate with a ground station or relay control signals through satellite systems.

Data link or radio control transmissions create a vulnerability. An adversary could jam or engage these signals or take command of the aircraft or at least intercept the downlink to determine what we are observing. Existing high power microwave or EMP technology already presents a significant threat to data link operations. [2]

The problem with MITL UAVs or any remotely controlled weapon is that they depend on vulnerable communications. If these links breakdown, or are disrupted, or sabotaged or, worse yet,manipulated by the enemy, the UAV becomes useless.

Like MITL UAVs, autonomous systems have their own problems and benefits. Independent UAVs will be different from the programmable cruise missile in that a cruise missile is preprogrammed to fly to a point in space.

The largest benefit is that this type of system does not require a vulnerable line of sight support infrastructure of hardware or personnel. Traditional aircraft maintenance systems will be required but once the system is airborne it will be on its own, free to carry out its specific mission

The human operator or airman will be required in several future roles. This does not lead to the demise of the UAV. The UAV represents a significant force multiplier and UAV technology should be exploited for all missions.

Airpower gives the USA an asymmetric advantage over every nation on Earth. This advantage is not created by technology but by highly trained men and women.

UAVs will play a large role in our future but airmen will be required to ensure that UAVs are employed correctly and manned aircraft will be vital for dealing with the uncertainties of war. Cooperation and unity of effort will be essential to the successful integration of UAVs, for any mission, into our force structure.

UAVs are a critical part of our future. UAVs will be an essential force multiplier and will enhance each Air Force core competency and thus make the nation stronger.

CONCLUSION

UAVs will play a significant role in future operations. However, the Air Force must not forget the significant contribution of the human operator. The Air Force cannot ignore the true nature of war. No matter how good the computer programmers are or the artificial intelligence becomes there is no substitute for the human brain.

The UAV, however, represents a significant force multiplier and UAV technology should be exploited for all

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missions, including the most complex, as a complement for manned systems. UAVs should be used in the following areas:

1. When the lethality of the airspace to be penetrated is too great for manned aircraft.
2. When the airspace to be penetrated is too politically risky for manned aircraft.
3. When the airspace to be penetrated is too toxic for human operators.
4. When lower priority missions could be performed by UAVs to free highly skilled airmen to handle higher priority tasks.
5. When overall mission effectiveness could be improved with UAVs.

UAV operations will expand the role of airmen. As more unmanned vehicles are pressed into service, airmen will be required to lend their unique expertise to operating these aircraft. Airmen will provide the following to a force employing UAVs:

1. Provide airmindedness and leadership to the control of MITL UAV operations.
2. Become specialists for specific UAV airframe capabilities and limitations.
3. Assist in the development of high fidelity simulators to provide realistic training for MITL UAV crews.
4. Assist design and software engineers in the baselining of software for programmable and independent autonomous UAVs.
5. Assist design and software engineers with updating tactics in the software baseline of programmable and independent autonomous UAVs.
6. Advise staffs on employment of UAVs in a manner consistent with mission requirements and the tactical situation at hand.

Airpower currently gives, for example, the USA an asymmetric military advantage over every nation on Earth. This advantage is not created by technology but by highly trained men and women. UAVs will play a large role in our future but airmen will be required to ensure that UAVs are employed correctly and manned aircraft will be vital for dealing with the uncertainties of war. Cooperation and unity of effort will be essential to the successful integration of UAVs.

Tab. 1 UAV Classification Table [1]

Class	Category	Normal employment	Normal Operating Altitude	Normal Mission Radius	Primary Supported Commander	Example platform
CLASS I (less than 150 kg)	SMALL >20 kg	Tactical Unit (employs launch system)	Up to 5K ft AGL	50 km (LOS)	BN/Regt, BG	Luna, Hermes 90
	MINI 2-20 kg	Tactical Sub-unit (manual launch)	Up to 3K ft AGL	25 km (LOS)	Coy/Sqn	Scan Eagle, Skylark, Raven, DH3, Aladin, Strix
	MICRO <2 kg	Tactical Pl, Sect, Individual (single operator)	Up to 200 ft AGL	5 km (LOS)	Pl, Sect	Black Widow
CLASS II (150 kg to 600 kg)	TACTICAL	Tactical Formation	Up to 10,000 ft AGL	200 km (LOS)	Bde Comd	Sperwer, Iview 250, Hermes 450, Aerostar, Ranger
CLASS III (more than 600 kg)	Strike/ Combat	Strategic/National	Up to 65,000 ft	Unlimited (BLOS)	Theatre COM	
	HALE	Strategic/National	Up to 65,000 ft	Unlimited (BLOS)	Theatre COM	Global Hawk
	MALE	Operational/Theatre	Up to 45,000 ft MSL	Unlimited (BLOS)	JTF COM	Predator B, Predator A, Heron, Heron TP, Hermes 900

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