IFS Info 6/2000

Andrew Brookes

The prospects for Unmanned Aerial Vehicles

Table of Contents

On the author

Andrew Brookes is a former RAF bomber and reconnaissance pilot. He writes widely on aviation matters. He is currently the air analyst at the International Institute for Strategic Studies in London.

Introduction

Unmanned Aerial Vehicles (UAVs) date from anti-Zeppelin weapon trials in the First World War. However, other than acting as target drones, until recently UAVs were largely confined to surveillance duties. At the tactical level, they offered a casualty-free means of briefing commanders on what was happening on the battlefield. Strategically, longer-endurance and higher-flying UAVs promised an alternative to satellites at much lower cost. But in the light of operational experience over Kosovo, and the resulting political fallout, this is a good time to re-evaluate the potential of UAVs.

Operational Experience

Half a dozen nations used UAVs to an unprecedented extent over Kosovo, with US Army *Hunters*, Navy *Pioneers* and Air Force *Predators* conducting important reconnaissance operations. German and French *CL-289*s made battle damage assessments and detected emerging targets in Kosovo, while British *Phoenix* completed most of the 250 missions flown by the type to date. On 12 June 1999, staff in the Combined Air Operations Centre in Italy could see Serb MiG-21s, hitherto hidden under the runway, taking-off from Pristina airfield before the Russians arrived. The pictures came from a camera in a *Predator*: the images were sent via data link to Mildenhall in Suffolk, thence to the Pentagon, and back out to all-takers including the Air Operations Centre, all in the space of 90 seconds.

NATO lost 20+ UAVs during the 78-day air operation, of which the US lost 10 *Predators, Hunters* and *Pioneers*. These figures were interesting on two counts. First, they put 20+ fewer lives at risk. Second, losses from Serbian ground fire and technical failures had little or no political impact, which would not have been the case if 20 pilots had been paraded through the streets of Belgrade. But it is salutatory to note that NATO faced a relatively weak air defence environment. While UAVs can now show air and ground commanders the real-time intelligence picture, allowing targets (and thereby crucial related factors like fusing) to be changed in mid-air, the Kosovo experience underlined UAVs' inherent vulnerability.

Future Requirements

The US Senate Armed Services Committee said in its report on Fiscal Year 2001 that, 'The American people are coming to expect that military operations are casualty-free.' The Committee chairman, John Warner, has thrown down the gauntlet by pronouncing that he would like to see one third of all operational US deep strike aircraft unmanned within a decade. This goal reinforces modern political pressure for a precise, all-weather strike capability to minimise civilian casualties, and a high war fighters' survival rate.

On the face of it, UAVs have much to offer on both counts. In 1995, the US flew 500 missions over 5 days to bring out Captain Scott O'Grady after his F-16 was brought down over Bosnia. UAVs should fly many of such combat search and rescue missions in future to avoid putting other aircrew at risk. UAVs can now loiter over a combat area for very long periods. *Global Hawk*, which is built to climb to 65,000ft and fly for 40 continuous hours to conduct reconnaissance for up to 24 hours at a radius of 3,000 miles, made the first round-trip, non-stop, unescorted, unrefuelled flight by an UAV from the US to Europe on 10 May 2000. *Global Hawk* is flown via computer from 'ground control' and its on-board sensors are designed 'to provide continuous day/night, high altitude, all-weather surveillance in direct support of Allied ground and air forces across the spectrum of conflict.' On paper, *Global Hawk* will make an ideal replacement for the U-2 reconnaissance aircraft which, forty years after Gary Powers was shot down, is still flying operational missions every day from bases in South Korea, Europe, Saudi Arabia and the US.

Less ambitiously, the Australians are looking at *Global Hawk* for coastal and maritime patrol, and they will conduct a month-long in-country evaluation of the UAV next April to see if it could at least compliment its P-3C force.

There is a downside. Although the Pentagon set a price goal of $10 million for each *Global Hawk,* the most recent contractor's projection is an average flyaway price of $15.3 million. As *Global Hawk* is a large 44-ft long aircraft with a wingspan of 116ft, it cannot just stumble around the busy skies. To comply with civil aviation regulations incurs added costs, both in payload that has to be devoted to safe operation rather than operational kit, and support teams on the ground. *Global Hawk* may be 'uninhabited' aloft, but as long as it needs a ground control organisation of Houston Mission Control proportions, manned U-2 or P-3 aircraft will have the edge in support costs, payload and mission flexibility.

Coming Soon – The Killer UAVs

Over Kosovo, a *Predator* became the first US UAV to designate a target for an A-10- launched laser-guided bomb. *Pioneers* also helped find targets for Boeing AGM-84 Stand-off Land Attack Missiles (SLAM) fired from US Navy P-3C Orions. It now seems perverse to use expensive strike aircraft (each costing around $50million) to deliver precision munitions when UAVs could do the whole job: i.e. real-time command and control, target verification and designation, and low-weight bomb delivery.

Boeing is designing an Uninhabited Combat Air Vehicle (UCAV) around a high subsonic speed, 500-1,000 mile mission radius and 1,000-3,000lb payload capability. It is being developed to be airlifted into theatre – 6 per C-17, or 12 per C-5 – and thereafter to suppress enemy air defences and to perform lethal strike missions. Next year, Boeing and the US Air Force plan to launch the first X-45 small-scale version of UCAV on its maiden test flight. The development programme will culminate in a mission during which two UCAVs autonomously will detect, identify and strike a surface-to-air missile site while simultaneously evading enemy air defences. All being well, the US UCAV should come on stream sometime after 2010.

However, although the technology now exists for UAVs to deliver weapons as well as identify targets, it will take much time and mental readjustment before robots are allowed to kill. Although there is little difference between a UAV and a cruise missile – the former tends to come back – autonomous UCAV operations, with robot machines entrusted with making life and death decisions, may be a 'Brave New World' step too far. Moreover, a willingness to put lives on the line is the highest measure of national resolve; the threatened use of robots alone might be perceived as a sign of the most tentative commitment.

This is an age when evolving international law and targeting rules impose ever-stricter constraints. Last year, a *Global Hawk* crashed because its flight termination system was accidentally triggered by an abort signal from another UAV being tested more than 250km away. Over Kosovo, one French source has attributed the loss of two NATO UAVs to electromagnetic emissions from a jamming US Navy EA-6B *Prowler*. UCAV designers and engineers will have to meet very robust performance and reliability targets before politicians will give their creations wide freedom to operate. Until that time, while we can expect to see UCAVs increasingly flying at the outskirts of an aerial strike package undertaking the dangerous tasks of destroying enemy SAM sites and target designation, inhabited 'mother ships' will continue to control proceedings.

The Challenges

Just as a professional golf player needs a variety of clubs, an air commander intending to take on a host of targets in all weathers will do best if he can call on a mix of manned aircraft, UAV/UCAVs and cruise missiles.

Saab Technologies *Netdefence* concept is a good example of the way forward. *Netdefence* envisages a smorgasbord of UAVs designed to operate alongside the Swedish Air Force's main manned aircraft – the airborne early warning S100 *Argus* and JAS39 *Gripen* multirole fighter. Above all would be the high altitude, long endurance (HALE) *Gladen* carrying Ericsson's *Erieye* AEW radar, *Carabas* foliage penetration radar, synthetic-aperture imaging radar or other surveillance payload. At medium level there would be the *Skuadern* strike reconnaissance UAV. *Skuadern* would be expected to go where it was no longer safe for man to go, reconnoitring targets for attack by the manned *Gripen*, which would leave behind a *Getoga* UAV to undertake a damage assessment, monitor recovery efforts, and summon a second strike if needed. Saab has a design for an UCAV to take on those missions too dangerous for *Gripen*.

UAVs will prosper by playing to their strengths. Over Kosovo, UAVs were found to be well suited to land mine detection and watching over returning refugees. As machines are best at remote sensing and communications, UAVs offer much when it comes to chemical and radiological sampling in the event of another Chernobyl, or providing a surrogate reconnaissance or communication satellite service.

We can expect to see new families of UAVs filling the gap between slow and long-ranging *Global Hawk*, and the low, fast-flying and lethal UCAV. The future lies in miniaturisation, with individual troop companies having their own dedicated UAV in their rucksack. Northrop Grumman is working on a Miniature Air-Launched Interceptor technology demonstrator, designed to prove that a swarm of inexpensive, self-organising, lethal UAVs can counter incoming cruise missiles. But success in the UAV race will not just go to the most technologically adept, but rather to those positioned at the point where manned platforms and UAVs 'intersect'. At this stage, 'smart' UAVs and UCAVs will complement sophisticated inhabited aircraft as much as replace them.

Technological developments and reduced military manpower levels combine to give UAVs a variety of roles across the spectrum of operations. UAVs can provide disaster relief and environmental monitoring information. They are well suited to the tedious but vital confidence-building Open Skies verification work. They can also do much to help counter-drug, sanctions enforcement, counter-insurgency and counter-terrorism activities. But a UAV is not a vacuum cleaner. Development and production of high quality, lower cost sensors will have to parallel those in airframes. The aims must be to make the UAV both a discerning, real-time system and an almost disposable item.

UAV vulnerability was clear over Kosovo. The Serbs knew what they were up against – the remains of a shot-down *Predator* had been on display in the Yugoslav Air Force Museum in Belgrade since 1995. As the majority of NATO UAV units were based in Macedonia, geography played into the hands of Serb defenders because they had only to plan on UAVs approaching from a limited number of directions. It was therefore easy to position guns and hand-held heat-seeking missiles under likely UAV flight paths. The most innovative Serb tactic was to fly a *Hip* helicopter alongside a UAV so that the door gunner could blast it out of the sky with a 7.62mm machine gun. Had the conflict continued NATO might have had to restrict UAVs to almost wholly night operations to reduce attrition rates on the small number of airframes available.

Just as many nations are eyeing UAVs as *the* military acquisition of the moment, so anti-aircraft defence teams are designing weapons to shoot down the highly intrusive UAVs that may soon be coming. In an age where winning the economic contest is as important as winning the military contest, the ideal aim must be to procure a fleet of UAVs that cost less than the missiles positioned to shoot them down.

While UAVs are increasingly being seen as integral parts of an overarching intelligence or strike system rather than just platforms, there are other challenges still to be faced. First, much will have to be done to integrate UAVs into a complex battle space full of manned aircraft and anti-aircraft weapons. For a small nation, Sweden's UAV plans are ambitious but not unique. However, they will only work if *Argus*, *Gripen*, *Gladen* and *Skuadern* are nodes on the came C3I web, connected by a broad-band network that is compatible with all other military formations with which the Swedes could be involved in coalition operations. Such seamless interoperability will become even more important once micro and palm-held UAVs arrive in service.

Second, only 66% of Kosovo UAV missions were completely fault free. A reputation for unreliability will limit UAV use and put doubt into a commander's mind as to whether to use the system at all. UAV designers and users must strive for the same reliability levels, and associated strict inspection regimes, as for manned aircraft. Civil aviation authorities will certainly not allow free access to UAVs until the machines, systems therein and people who maintain and operate them are up to acceptable safety standards.

Third, much effort will be required in the unsexy but crucial fields of digitisation and expanded bandwidths. The Kosovo experience showed that UAVs are opening the door to micro-management of operations by senior politicians and commanders far removed from the action. But UAVs should not be procured to enable the great and the good to watch an unfolding soap opera, but rather to enable them to make better, timely decisions. And the key to military and political success in future will rely on the successful passage of real-time information. Commanders, and even prime ministers, may insist on seeing for themselves before they will authorise an engagement. Providing the necessary bandwidth for real-time targeting video will be expensive, but it may be essential in an age when the media is screaming for 'the truth' and evidence is needed that will stand up in an international court.

Fourth, the Kosovo system, whereby German, French and British UAV assets remained under the command of their respective brigades, is inadequate. Co-ordination of UAV activities was not of the best, and on occasions even US-controlled *Predators* and *Hunters* were sent to the same target and ended up filming each other. There can be no place in the modern battlefield for complex and convoluted chains of command. The answer lies in a culture change.

British operational UAV expertise is largely confined to the Royal Artillery because *Phoenix* was originally procured to target long-range artillery. This grafting of UAVs onto established military structures is both typical and understandable, but as UAVs become integrated into wider intelligence, target acquisition, and surveillance systems, or become strike vehicles, the doctrine that underpins their employment and operation will need to grow beyond that of a gunnery culture. Across the Atlantic, UAVs are procured, financed and generally compartmentalised just like any other single-service weapons system. Neither the US nor the British approach is a good foundation for getting the best out of a revolutionary new way of doing security business. Sooner rather than later, smart defence ministries should invest a tri-service 'UAV Supremo' with the wherewithal to forge a coherent intelligence, surveillance, target acquisition, strike support and reconnaissance UAV doctrine and capability.

Conclusion

It is a measure of the demonstrable usefulness and potential of UAVs that many nations have added these systems to their military inventories over the past 5 years. This is because UAVs have come of age. Gone are the days when the nation that created the Spitfire and Concorde could not put together the *Phoenix* – not much more than a scaled-up model aircraft powered by a glorified lawnmower engine – in anything like the original timeframe or budget. After numerous false starts and flawed procurement programmes, the latest UAV/UCAV generation is serious aviation. UAVs have a bright future, which is more than can be said for tanks or heavy artillery.

But while UAVs keep aircrew out of harm's way, they are not a panacea. Maximum cruise speed for tactical *Hunter* and *Phoenix* is no more than 85kts flat out, which can mean long transit times between targets during which time the bird could have flown. UAVs lack an all-weather capability because their wings can ice up, which means that Phoenix and Hunter only work over the former Yugoslavia from spring to autumn. Moreover, they are not cheap. Pentagon staffs are finding that UAVs are costing more than they expected by a factor of four.

Although UAVs are the military fashion of the moment, it should never be forgotten that they are not a capability in themselves – they are 'enablers' to attain a capability. In other words, UAVs should only be procured if they are the most effective means of fulfilling a task. For the foreseeable future, manned aircraft and cruise missiles will continue to execute some tasks far better than UAVs, which means that the best military air option is a mix of all three. That said, as UAVs become technologically robust, and politicians learn to trust them and accept that some of these far-from-cheap systems will not come back, we can expect to see a qualified, progressive expansion in UAV roles, capabilities and numbers over the next 20 years.

Characteristics of selected UAVs

Characteristics of selected UAVs						
Company	Designation	Country	Role	Max speed (km/hr)	Operating radius (km)	Endurance (hrs)
BAe Systems	Phoenix	UK	Surv/ta	155	70	4,5
Yakovlev	Pchela	RF	Surv/ta	150	50	2
Xian	ASN-105	PRC	Recce/Surv	205	100	2
Bomb/Dorn	CL-289	Int	Surv	740	200	0,5
General Atomics	Predator	US	Recce	200	925	24
Northrop Grumman	Global Hawk	US	Surv	635	4800	42

Abbreviations:

Bomb/Dorn - Bombardier/Dornier
Int - International
Recce - reconnaissance
Surv - surveillance
TA - target acquisition