In the complex and high density modern battlefield, missile-armed uninhabited aerial vehicles (UAV) have become an accepted and ubiquitous presence over the past few years. What these platforms offer is long loiter times compared to manned equivalents, demonstrating a persistent on-call precision strike capability. They, however, do not have autonomy or any other combat characteristics, or even the aerodynamics needed to operate as a dedicated air-to-air fighting platform. These are the fundamental characteristics required in a true uninhabited combat aerial vehicle (UCAV). So, the question is whether or not the concept of an operational UCAV is too far-fetched to be converted to reality in the near to mid-term future?

As in the case of most air power concepts, the UCAV concept was developed almost in parallel to the early flights of unmanned drones. The confirmed success of uninhabited flights and their immediate maturity for battlefield use gave rise to the concept of them being employed in combat duties. The advantage of such a combat platform, especially in carrying out dull, dirty and dangerous missions that would place aircrew under unacceptable risk, was readily recognised. However, until quite recently the technology required to develop platforms with the necessary capabilities were either not available or were only in their initial development stage.

Now it is believed that the technological challenges that stymied the growth of the UCAV concept into reality can be ameliorated. Composite material technology has advanced enough to provide the necessary impetus to UCAV development with work in the field of artificial intelligence and computer generated autonomy fairly well advanced—enough to make enthusiasts predict the imminent arrival of the complete UCAV in its operational debut. There are, however, a number of issues to be addressed before this dream can become a reality.

The first issue, as in the case of all cutting edge developments, is the cost factor. An autonomous UCAV will cost a great deal more than the currently operational UAVs. Further, any design that incorporates stealth will make the cost of development as well as the unit price of the platform go up even more. Under these conditions, the affordability of UCAVs—in the numbers that are being predicted—would perhaps remain a question mark, thereby restricting their operational employment to few air forces. This could also be thought about as a silver lining, because the overall identification and integration of UCAVs in combat conditions could well prove to be a quagmire.

Second; the need for high speed capability in UCAVs, because of their perceived use to defeat sophisticated air defences in the first day of a war with minimum attrition. This requirement translates to more powerful engines, greater fuel carrying capacity and larger number of dedicated weapons, which in turn will make the vehicle a much larger platform than any of the current UAVs. The technical and operational sophistication required to employ UCAVs will also increase the logistical footprint correspondingly.

The third issue, which may be the most difficult to overcome, is the fact that future UCAVs are conceptually meant to operate in hostile air spaces, whereas the current UAV operations are almost completely restricted to benign and uncontested air space. The characteristics of the vehicles required to operate in both these situations are very different and extremely difficult to incorporate into a single entity. More than that, for optimum effectiveness, UCAVs need to be able to operate as self-contained platforms from their launch to recovery, much in the same way as manned combat aircraft operate. This requires granting significant autonomy to on-board artificial intelligence and other data processing capabilities. Even if artificial intelligence development reaches a theoretical point of fool-proof validation, it is difficult to imagine any government
allowing autonomous UCAV operations in today’s restrictive political and strategic environment.

Even in circumstances where only limited numbers of friendly UCAVs are operating, a critical issue that is yet to be resolved is the need for the UCAVs to be able to communicate effectively with each other and manned aircraft both to avoid collision and to disseminate data that has been gathered by their on-board sensors ahead of the manned package arriving in the battlefield. However, rapid improvements in communications technology may ease the situation fairly soon.

Even before any success has been achieved in operationally employing UCAVs, there is already a growing belief that two independent, mission-oriented types of UCAVs need to be developed simultaneously. The first would be the strike platforms that are meant to open up the enemy air defences in the initial stages of the war and send back collected data in real-time and the second would be UCAVs optimised for air combat that will protect the strike platforms from enemy fighters and other airborne threats. In addition, there would also be the need to have stealthy tanker UAVs with autonomous refuelling capabilities to enhance the range of the entire strike package. The scenario has suddenly become extremely complicated! For the time being however, the UCAVs being developed are being designed with stealth characteristics as their primary self-defence. This is expected to allow the strike UCAVs to operate without supporting packages.

The real issue is actually not so much whether a truly autonomous UCAV can be built, but its suitability and affordability as an alternative to other conventional strike packages. As in any other case, trade-offs between survivability, onboard sensor suites, weapon carriage capability and combat performance requirements would have to be made, within the constraints of finite resources. The problem here is that the UCAV does not have the mitigating factor of a human on board to smooth over inherent drawbacks in performance and capability.

Even with all these teething problems, UCAVs will become a reality sooner rather than later. What has to be understood very clearly, by planners and operators alike, is the fact that even after UCAVs become a viable option for employment in extremely dangerous situations, they are not an instant panacea to problems that face the conduct of air strikes. They lack the spatial awareness and judgement inherent in a manned aircraft, and the intuitive ‘sixth sense’ that a pilot’s peripheral vision brings in moments of extreme stress and danger. At least for the foreseeable future, application of air power will be most effective and efficient when carried out with a human in-the-loop.

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• Technological advances in composites and artificial intelligence have reinvigorated the development process of Uninhabited Combat Aerial Vehicles

• There are still a number of issues to be ameliorated before any meaningful employment of UCAVs can be undertaken

• The level of autonomy that can be granted to future UCAVs, even those with the most advanced artificial intelligence on-board, will have to be decided at the highest political level

“The bias toward the offensive creates special problems in any technologically new situation where there is little or no relevant war experience to help one reach a balanced judgement.”

Bernard Brodie