TECHNOLOGY: CREATING THE NEXT STEP-CHANGE IN AIR POWER

'The pace of progress in artificial intelligence is incredibly fast. Unless you have direct exposure to groups like Deepmind, you have no idea how fast—it is growing at a pace close to exponential.'

Elon Musk, comment in *Edge.org*

In the past few decades the effectiveness of the application of military power has become dependent on the ability of the force to be joint, moving towards integrated, especially in the more technologically advanced military forces of the world. A detailed analysis of this trend would find that even within the joint application of military forces, air power tends to be at the vanguard in the majority of the cases. This trend is unlikely to change because of a number of factors, the most important being the necessity to limit one's own casualties in all operations. Air power with its promise of relatively low casualties, at least to it's own forces, therefore becomes the weapon of first choice in all conflicts other than wars of necessity.

The pursuit of control of the air—because the air environment envelopes all other physical domains—has normally dominated the development, employment and efficacy of air power and it will continue to define future developments. In this context the air environment can be characterised as permissive or benign, contested, or denied. In the past fifty or so years, Western nations with adequate air power have not had to operate in any other but a permissive air environment, never having to really fight to obtain control of the air. While this situation has ushered in a sense of complacency, the future may not be the same. A benign air environment could become contested very rapidly and emerging threats could lead to a denied air environment. Under these circumstances, successful air operations could become difficult at best.

An MQ-9 Reaper over southern Afghanistan, armed with GBU-12 Paveway II laser guided munitions and AGM-114 Hellfire missiles (Photo: US Air Force)

The possibility of a change from a benign to a contested environment has influenced the development of air power capabilities and created a 'system of systems' concept. In this concept, air power capabilities that may have been resident in individual platforms are combined into one 'system' that may not be a single platform but a group that functions as a single system. Uninhabited Aerial Vehicles (UAVs) on ISR missions, operating in conjunction with 4.5-generation strike aircraft provide an early example of this development. It is envisaged that the system of systems approach will culminate in making air power a seamless web capable of masking its vulnerabilities, and dominating contested, or even denied air spaces successfully.

However, only a step-change function in air power capabilities will bring about changes to the manner in which air power is generated, sustained and employed. Two such functions can be identified—the uninhabited combat aerial vehicle (UCAV) and artificial intelligence (AI). Both UCAVs and AI, when fully incorporated into the concept of air power—meaning incorporated into the development, application and sustainment activities—will change the realities regarding the application of air power as perceived today.

The UCAV, a system that combines ISR and strike capabilities, has matured to a level that it is now routinely used to strike time-sensitive targets, especially in the context of irregular wars. This system combines long-term surveillance and near real-time kinetic response,

which could be considered a step-change function that has altered the application of air power.

While the UCAV systems have clearly indicated future possibilities, they continue to function with a 'human-in-the-loop' in its decision-making cycle. The application of lethal force continues to be authorised by human beings for a variety of reasons such as ethics, morality and international law. Therefore, the UCAV system sits at a half-way point between traditional strikes from inhabited platforms and the concept of complete autonomy with regard to the weapon release function.

A number of unresolved issues and challenges continue to inhibit their unrestricted use, even as UCAVs are being employed almost in a routine fashion in the on-going conflicts in the Middle-East and South Asia. The legal status of the UCAV operators vis-à-vis the Law of Armed Conflict, the cost-benefit analysis of their use, the per unit cost escalation, and survivability in contested air spaces are some of the issues to be resolved. Further, the efficacy of UCAVs will have to be re-evaluated if they are to operate in a contested air environment. However, if these challenges are overcome and a visionary approach to the concept of their employment is adopted, UCAVs will provide a step-change function to the employment of air power.

The concept of autonomy in weapon release, from an air power perspective, is closely related to the employment of AI in warfighting functions. Even as the employment of UCAVs have created a number of challenges to military forces, mainly in terms of legal, moral and ethical considerations, the advent of AI adds a new challenge and complicates older ones. Viewed in an unbiased manner, future concepts of operation and emerging employment opportunities that combine UCAVs and AI into a single system point towards a step change function in the application of air power.

Defining AI in a generic sense is not possible since it is an absolutely nuanced entity and means different things in different circumstances. In a military context, AI could be explained as the 'intelligence' introduced into a 'robot'—the term robot denoting any machine capable of perambulation and conducting its own activities regardless of the domain—to ensure that it functions in an autonomous manner with no human input for the full span of an independent mission. From a purely scientific feasibility point of view, autonomous operation is already a reality.

The operational employment of a UCAV-AI combination for the application of lethal force brings out discernible conceptual and mental challenges. Irrespective of the challenges to the employment of AI, its introduction into the decision-making cycle is considered possible in the not too distant future. However, there is still a general lack of trust in AI, due to such factors as: the fear of a 'wrong' decision being made with disastrous consequences; the inherent human tendency to resist change; and the apprehension of not being in control, compounded by the inherent human need to maintain superiority over machines, individually and in combination. All of these issues inhibit the unrestricted use of AI.

Stemming from the purely cognitive human element of trust, there is also a clearly visible reluctance at the strategic decision-making level to give complete freedom of operation to fully automated combat vehicles. For some inexplicable reason, this reluctance is reinforced when the combination is part of air power, perhaps stemming from the fear of collateral damage from a UCAV-AI combination. Considering the challenges, mostly originating in human reluctance to trust AI, it would seem that the fully autonomous application of lethal air power is still a faraway dream. However, the technical capability exists to achieve this step-change function.

It is difficult to predict the timeframe within which the UCAV-AI combination will find its niche in air power. With its maturation, air power will transcend another invisible step in being the power projection capability of choice. There is no doubt that an AI capable of making weapon release decisions without a human-in-the-loop will be fielded at the operational and tactical levels of war sooner rather than later. Even though the acceptance of such a situation will be incremental, it is bound to start in the not too distant future.

Key Points

- *The pursuit of control of the air has dominated the development, employment and efficacy of air power*

- *Technology-enabled step-change functions will change the realities regarding the application of air power as perceived today*

- *The UCAV-AI combination capable of autonomous operations will find its niche in air power, sooner rather than later*