Next Generation Intelligence, Surveillance, and Reconnaissance (ISR)

When Sensors are Shooters

By John Antal

The trend in ISR is to merge ISR and strike capabilities into the same platform. Future ISR systems will be smaller, lighter, unmanned, and armed with long-range-precision-guided munitions. (Turkish Defense Industries SSB photo)

In the fall of 2020, the Second Nagorno-Karabakh War provided a glimpse of what the next generation of Intelligence, Surveillance, and Reconnaissance (ISR) will become: precision-guided munitions with active sensors. In the past, ISR platforms primarily found targets for other systems to destroy. The recent fighting in the Caucasus, which involved two, near-equal medium powers, has shown how ISR and Precision-Guided Munitions (PGMs) are now blending to become one. During this conflict, the Azerbaijani forces used strike systems, Unmanned Air Combat Vehicles (UCAVs) and Loitering Munitions (LMs) for ISR. These systems had high-end, active sensors that generated real-time intelligence during combat. In addition, they provided accurate, real-time, battle damage assessment. In the next decade, strike systems will become smaller, less expensive, and better networked. The lessons learned for next generation ISR from this conflict is dramatic, and was a key factor in Azerbaijan's decisive victory. Some of the primary systems used by Azerbaijan, principally the TB2 UCAV and the HAROP LM, provide an important insight into the future of ISR systems.

Turkey's TB2 UCAV, with its distinctive triangular tail section and loaded with MAM-L micro-missiles, was a major factor in Azerbaijan's war with Armenia in the fall of 2020. (Bayhaluk photo)

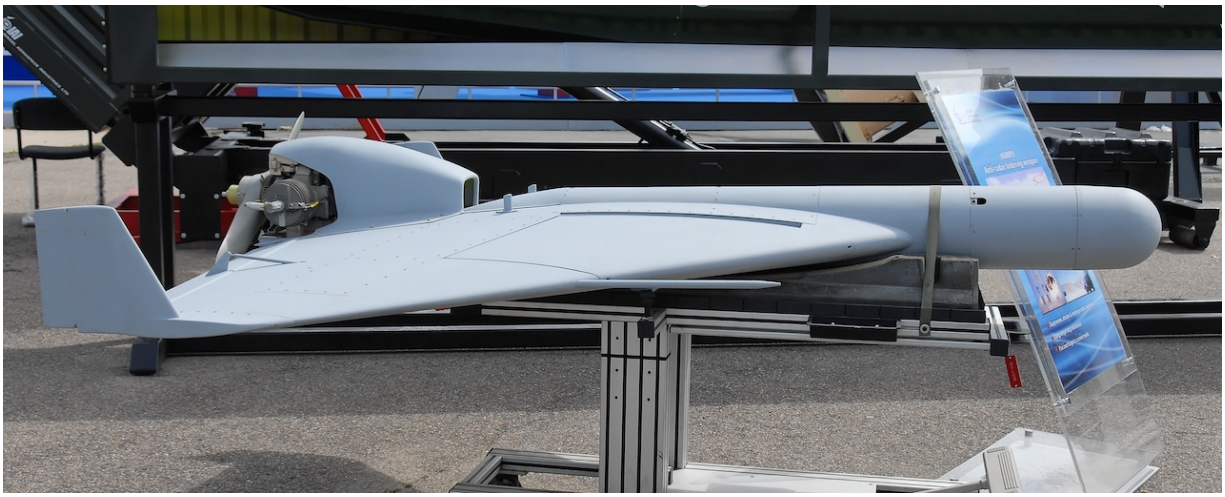
The TB2 UCAV

The BAYRAKTAR TB2 medium altitude, long endurance (MALE) UCAV was the star of the Azerbaijani war effort and is the premier product of family-run, Turkish defense company, Baykar. Headquartered in Istanbul, Turkey, Baykar operates under the names "Baykar Savunma" (Baykar Defense) and "Baykar Makina Sanayi ve Ticaret A.Ş." (Baykar Machine Industry and Trade Inc.). The Chief Technical Officer of Baykar Makina, Selcuk Bayraktar, studied UAV development while earning his master's degrees at the University of Pennsylvania, and later the Massachusetts Institute of Technology, is also the son-in-law of Turkish President Recep Tayyip Erdoğan. The TB2 that Bayraktar produces is Turkey's first, indigenous armed reconnaissance UCAV. Operators pilot the craft from a ground control station (GCS) by direct radio link or via Turkey's TüRKSAT satellite network. During the Second Nagorno-Karabakh War, the TB2 found and destroyed Armenian tanks, infantry fighting vehicles, artillery and infantry positions. The impressive list of successfully destroyed targets included the BM-30 Smerch Multiple Rocket Launcher System (MRLS), the 9K33 Osa (NATO designation: SA-8), and five S-300 (NATO reporting name SA-10 Grumble) air defense systems. Of the 200 artillery pieces confirmed by Armenia that were lost in the war, they claimed the TB2s destroyed 120.

The TB2 is 6.5 meters long, with a wingspan of 12 meters, a distinctive inverted V-tail, and a pusher propeller. The two-blade, variable pitch propeller is powered by a 100-horsepower ROTAX 912 gasoline internal combustion engine. The cruising speed is 70 knots and the maximum speed is 135 knots. Cruising altitude is 22,500 feet with a maximum altitude of 25,000 feet. Although a Turkish design, many of the original components, including the transponder,

engine, electro-optical (EO), micro-munition bomb rack design, and other technologies came from other countries, many of them members of NATO. Some of these manufacturers stopped selling their products directly to Turkey when Armenian social media displayed the manufacturer logos and component markings from the wreckage of several TB2s that were downed in the fighting. Turkey is now working with Ukraine and other suppliers to secure an alternative source for engines, EO systems and miscellaneous components.

To engage targets identified by its EO sensors, the UCAV carries Turkish MAM (Mini Akıllı Mühimmat) laser-guided smart micro-munitions developed by Turkish defense industry manufacturer ROKETSAN. The TB2 has four hard-points that can carry two MAM-C and two MAM-L micro munitions, or four MAM-Ls. The MAM-C has a multi-purpose warhead (blast fragmentation, incendiary and armor piercing) and a high-explosive blast fragmentation variant. The MAM-C weighs 6.5 kg, is 70mm long, and has a range of 8 km. MAM-L has a tandem warhead variant, effective against reactive armor, and high-explosive blast fragmentation, and thermobaric warhead versions. The MAM-L weighs only 22 kg, and is one meter long, and can be used to engage stationary or moving targets with high precision within a range of 8 km. The range can be extended to 14 km with the Inertial Navigation System/Global Positioning System option. Selçuk Yaşar, president and CEO of ROKETSAN, emphasized the multi-role ISR and strike capability of the TB2: “The design and application concept of the Smart Micro Guided Munitions allow operators to effectively neutralize time-critical targets, particularly those that arise during reconnaissance and surveillance missions. Meanwhile, thanks to their precision guidance and small dimensions, they offer a solution with a low collateral damage. When compared with all the other capabilities of the armed forces, a combination of the Smart Micro Guided Munitions and a tactical UAV is the most cost-effective solution. We believe that other countries will also start taking an interest in this solution soon.” With the success the TB2 experienced during the Second Nagorno-Karabakh War, ROKETSTAN is exporting the system to new customers around the world, including Ukraine and Pakistan.



A HAROP LM on display at the International Paris Air Show in 2007. (Photo by Jastrow)

The HAROP

The HAROP is a "kamikaze drone," loitering attack weapon that combines the characteristics of a missile and a UAV and is designed to locate and precisely engage stationary or moving targets. The LM concept is not new, but Israel Aerospace Industries (IAI) has turned the idea into a war-winning solution, particularly for military forces that do not have access to other long-range, precision-guided options. IAI designed and produced the HAROP LM in the early 2000s. Turkey became one of IAI's first customers for HAROP in 2005 and successfully employed the system in combat in Libya in 2018-2020. Turkey's ally, Azerbaijan, then became a major customer and IAI sold the HAROP system in ample quantities to the Azerbaijani military several years prior to the Second Nagorno-Karabakh War. The HAROP's primary purpose is to attack radar and anti-aircraft systems, but during the war, it destroyed a wide range of targets that included air defense systems, command posts, and convoys of Armenian soldiers traveling to the front lines. The shrill scream the HAROP generates during its terminal dive to the target is reminiscent of the WWII-era German Stuka dive bomber and had an equally demoralizing effect. When Armenian soldiers spotted or heard the HAROP, they knew they had only seven-seconds to take cover before the HAROP struck. One Armenian soldier stated: "There was no place to hide and no way to fight back."

The HAROP is EO guided and provides high-definition video of its flight and terminal attack. Accuracy is within 1-2 m. The HAROP is 2.5 m long with a wingspan of 3 m and weighs approximately 135 kg, including a 23 kg high-explosive (HE) fragmentation warhead. It has a nine-hour flight endurance, a range of about 1,000 km, and a maximum speed of 417 km/hr. During a mission, the HAROP can loiter, identify prescribed targets, dive into the target, or if no appropriate targets are identified, autonomously return to a designated landing strip. With its impressive range and loitering time of approximately six hours, the system can fly autonomously to a designated strike zone to identify targets that meet its targeting parameters. A human operator then gives the weapon the order to attack. According to IAI, "The HAROP LMs are programmed before launch by the Ground Control Station (GCS) to autonomously fly to a pre-defined 'Holding Area,' where they loiter. The MCS (mission control system) periodically checks their position and status during the route to the 'Holding Area.' The MCS operator can thus control a number of HAROP LMs that loiter over a 'Holding Area,' select one LM for target search and attack, while the others are monitored periodically. The operator directs the selected LM to the target area and uses the video image to select a target, and to attack it. The HAROP tracks the target and then dives on it, detonating the warhead upon impact. If required, the attack can be aborted and the operator can re-attack with the same LM."

In the past two years, the HAROP Loitering Munition (LM) proved its lethal combat effectiveness in conflicts in Libya, Syria and Nagorno-Karabakh.

HAROPs can be fired from truck-mounted "MRLS-like" platforms to create an ISR-strike capability that only elite air forces had in the past. Considering the fleeting engagement times of modern combat, the convergence of "find and strike" provides smaller forces with an important combat multiplier. This capability is particularly useful for expeditionary units. Due to its well-publicized success during the Second Nagorno-Karabakh War, IAI's HAROP has become a best-selling system and has been added to the arsenals of Azerbaijan, China, India, South Korea and Turkey. In February 2020, IAI announced it had sold a naval version of the HAROP system in three separate deals to an undisclosed customer in Asia for US $100 million. This maritime version of the HAROP has an extended range and will provide a combined ISR and a lethal strike capability to a wide variety of naval platforms. It could even be installed on a cargo ship.

With accelerated technological change, the methods of war are evolving, and so are the means to conduct ISR and strike missions. In the decade to come, many ISR systems already fielded will continue in the traditional mode of providing ISR information for other munitions, but an ever-increasing number of platforms will combine ISR and attack. Merging both capabilities into one system creates a powerful combination and this points to a trend for smaller, unmanned platforms with multiple roles. UAVs, which were primarily ISR platforms in the past, are now less expensive, more available, and capable of performing both ISR and strike roles. As we connect more projectiles to a networked Internet of Battlefield Things (IOBT), sensors embedded in projectiles will "light up" the surrounding battlespace as they fly to their targets, identifying

enemy systems along their route. When this occurs, the battlespace will become transparent. When we network these systems into an interconnected, multi-domain strike capability, and leverage the synchronization in time, space and effect with Artificial Intelligence (AI), the ability for weapon systems to hide in the battlespace will become nearly impossible. To counter this, new ground combat systems must be built from the ground up, using passive and active means, to mask themselves from these ubiquitous sensors to become difficult to identify and target. The merging of ISR and strike capability, when sensors are shooters, represents a capability tested in recent combat and foretells the evolution of next generation of ISR systems.

John Antal is a military thinker, defense analyst, and correspondent who has served as a member of the US Army Science Board. He retired from the US Army after 30-years in uniform, with 26-years commanding tank and cavalry units from platoon to regiment. He is a graduate of the United States Military Academy, the Command and General Staff College, and the US Army War College. He has worked for Microsoft Corporation and as a consultant for a number of military defense companies. John has been hosted on radio, podcast, and television shows to discuss military topics and is the author of 16 books and hundreds of magazine articles on military and leadership subjects.

Author's Page: https://www.amazon.com/author/antal

Articles Page: https://johnantal.academia.edu/