

UAS Employment by Azerbaijan in the 2020 Nagorno-Karabakh War: Implications for Training at the Marine Corps Mountain Warfare Training Center and Joint Force Evolution



Frame capture of a video released by the Ministry of Defense of Azerbaijan that shows the engagement of an Armenian Army 122mm 2A18 (D-30) towed howitzer by an Azerbaijani UAS and subsequent overflight (left side of image) of an Azerbaijani *Orbiter 1K* (Aeronautics Defense Systems - Israel) during the 2020 Nagorno-Karabakh War. Credit: Ministry of Defense of Azerbaijan / enhanced for clarity by Ed Darack.

BOTTOM LINE UP FRONT:

Using Azerbaijani UAS employment in the 2020 Nagorno-Karabakh War as a model, in whole or in part, for simulations and exercise design in training conducted at MCMWTC will reap tremendous rewards for the Joint Force as: A) Azerbaijan demonstrated current and emerging unmanned capabilities that may be used by potential competitors of the United States and ally nations, and B) this proposed training will further propel the evolution of Joint Force unmanned operational / integration / teaming capabilities.

SUMMARY OVERVIEW:

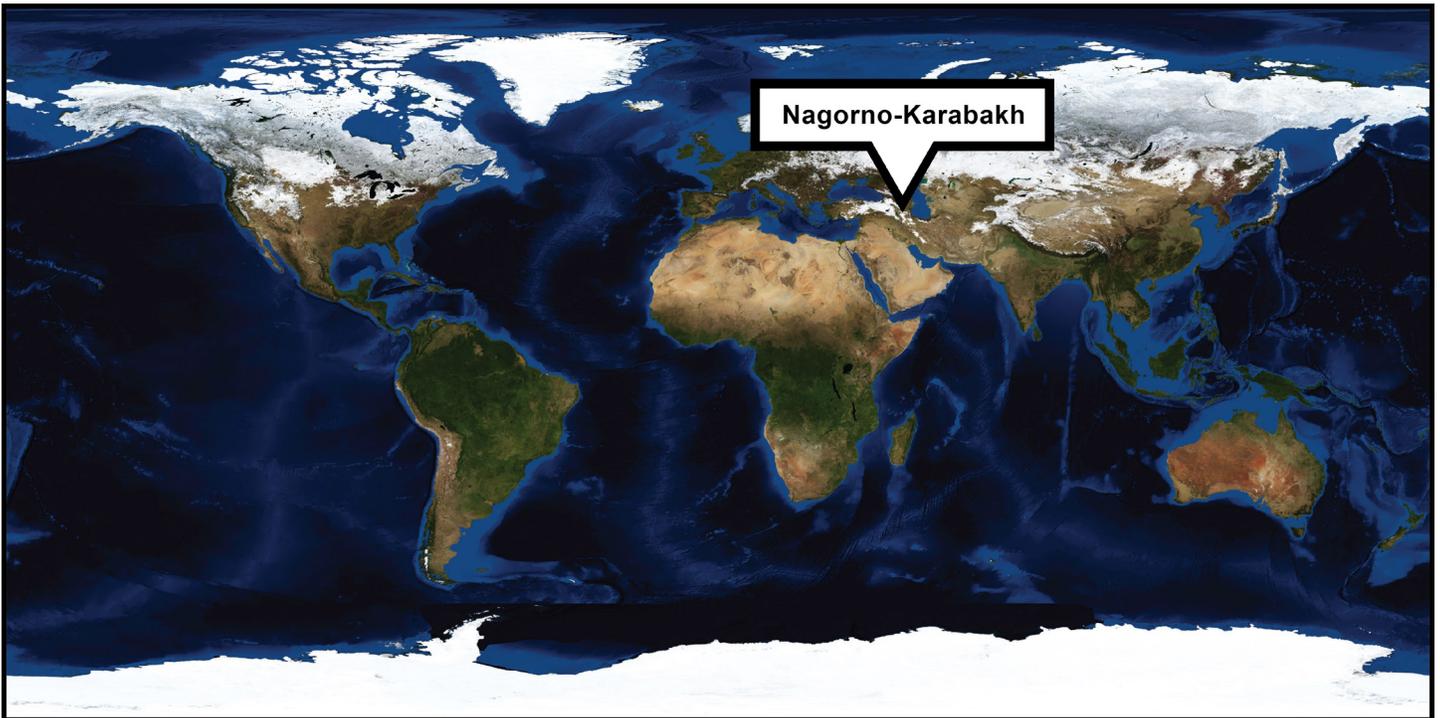
The 2020 Nagorno-Karabakh War, fought from 27 September to 10 November 2020 between Azerbaijan and Armenia, culminated in an overwhelming victory for Azerbaijan after just 44 days of conflict. Azerbaijani forces prevailed in the mountainous Nagorno-Karabakh region so quickly and so resolutely as a result of their detailed integration of UAS (notably manned-unmanned teaming) within a well-orchestrated and highly-synchronized combined arms campaign. Waging their initiatives from within this framework allowed the Azerbaijanis to quickly and fluidly adapt to the dynamic conflict as it evolved and to consistently dominate the battlespace with precision tactical effects that, in aggregate, yielded desired operational end states and ultimately a stunning victory at the strategic level. Adding to the notability of the conflict's decisive outcome, the war was fought in a distributed manner throughout a complex, compartmentalized mountainous battlespace that presented significant obstacles throughout all warfighting functions to both forces. Azerbaijan's employment of UAS in the 2020 Nagorno-Karabakh War stands as the preeminent, proven, contemporary exemplar of the synergy capable through detailed integration of unmanned systems and manned-unmanned teaming within a combined arms architecture—in the most difficult of environments, proving its efficacy in *any* environment.

Adapting and incorporating key components of Azerbaijani UAS employment into training evolutions using simulated unmanned systems capabilities will yield tremendous value for the Joint Force for force-on-force training, for EXFOR tactics and operational models, and for ADFOR tactics and operational models. This will provide realistic, recently-demonstrated, and eminently-relevant scenarios where forces must operate in small units in a distributed manner within a contested environment with significant disruptions across the spectrum of warfighting functions. Darack Research has developed means for simulating all tactical effects achieved by Azerbaijani UAS (and other systems) through physically-delivered simulators that yield proven high-value psychological training effects. The Marine Corps Mountain Warfare Training Center, with its distinct physiographic similarities to the battlespace of the 2020 Nagorno-Karabakh War, is the most appropriate venue in the Department of Defense for recreating, in whole or in part, Azerbaijani UAS employment during its successful combined arms campaign of the 2020 Nagorno-Karabakh War.

Applying key components of Azerbaijani UAS employment in the conflict will tremendously further warfighting acumen of exercise forces, enhance and engender the development of ADFOR scenarios, spur the development of innovative unmanned systems and counter-unmanned systems TTPs, accelerate innovation of relevant unmanned systems technology, and provide a foundation from which similar training scenarios can be adapted for venues of all types of environments, including littoral, urban, jungle, and desert. The many dividends yielded by such training are eminently relevant in preparation for current and emerging threats in competition against peer, near-peer, and asymmetric adversaries throughout the world, notably those in USINDOPACOM, USEUCOM, and USCENTCOM. These dividends are highlighted goals for current Joint Force evolution in all of the following publications: National Security Strategy, National Defense Strategy, National Military Strategy, Commandant's Planning Guidance, Marine Corps Force Design 2030, and the Department of the Navy Unmanned Campaign Framework.

BACKGROUND - GEOGRAPHY - LOCATION:

Nagorno-Karabakh (alternatively called the Republic of Artsakh or the Nagorno-Karabakh Republic) is a landlocked territory within the border of the Republic of Azerbaijan and lies within USEUCOM’s assigned area of combatant command responsibility. Located in the Lesser Caucasus at the juncture of western Asia and eastern Europe, the region is roughly 1,700 square miles in area, mountainous, and comprises a small number of cities and many small villages.



Global locator map of Nagorno-Karabakh. Map by Ed Darack, based on NASA composite imagery.



Regional locator map of Nagorno-Karabakh (white area inside solid black). Map by Ed Darack.



Nagorno-Karabakh detail regional map. Map by Ed Darack.



Nagorno-Karabakh, showing topography and key population centers. Map by Ed Darack.

BACKGROUND - PHYSICAL GEOGRAPHY AND CLIMATE:

Nagorno-Karabakh is predominantly mountainous, with the Karabakh Range defining its western spine and the Murovdağ Range its far north. Elevations overall trend lower toward the east and south and higher toward the west and north. Elevations range from 1,250 feet above sea level on the region's southeastern reaches near the town of Martuni to its high point of Mount Gomshasar, 12,218 feet above sea level in its extreme north. Terrain is generally more compartmentalized in the higher western and northern aspects of the region, with open plains and plateaus interposed between gentler rolling terrain in the central and eastern aspects of Nagorno-Karabakh. Vegetation cover varies from agriculture fields in lower areas to dense stands of forest in the higher elevations, to bare rock in the very highest reaches.

The mountainous nature of the region, which presents tremendous logistical and physical obstacles to ground maneuver and mechanized units, is an important focal point of why UAS was so effective in this war, and sets a proven standard for UAS employment in a mountain warfare environment. While ground troops and vehicles were inhibited from movement due to environment, UAS operated relatively freely in the sky above. Even during times that meteorological conditions may prohibit manned aircraft operations in such environments, UAS, notably loitering munitions seeking pre-determined target grids, may operate without restraint. The nature of the terrain impedes line-of-sight communications and thus C2 architecture.

Nagorno-Karabakh experiences a humid subtropical climate. At the city of Stepanakert (2,667 feet above sea level), January, the coldest month, experiences an average diurnal low temperature of 27.3 degrees Fahrenheit and a high of 40.5 F. July, the hottest month, has an average daily high of 82.6 F and a nighttime low of 65.1 F. The region receives an annual average of 20 inches of precipitation, with May, the wettest month, accounting for 4 inches, or 20% of annual total. December is the driest, with .5 inches. Like all mountain regions, the Nagorno-Karabakh experiences pronounced microclimates throughout its reaches. This is critical for distributed operations, where one valley may experience clear skies, and another just a few miles distant, may experience fog.

BACKGROUND - HUMAN GEOGRAPHY:

Nagorno-Karabakh is populated by two primary groups, Armenians, who identify predominantly as Christian, and Azerbaijanis, who identify predominantly as Shia Muslims. Demographic information is lacking, but data suggest that the population lies somewhere between 140,000 and 175,000. Of this population, roughly 75% are Armenian, 23% are Azerbaijani, and 2% are of Russian and Kurdish descent.

Nagorno-Karabakh comprises a number of cities, towns, and villages within its border. The largest, Stepanakert, has a population of 55,000. Shusha (population 4,000), which lies just south of Stepanakert, is a location of great strategic importance as Azerbaijanis hold it to be the most important to them historically and culturally in Nagorno-Karabakh. Many of the towns of regional military significance have fewer than 1,000 inhabitants.

The economy in the region is agrarian-based. Orchards and vineyards are prevalent. A number of grains are grown, and animals such as cattle, sheep, and pigs are raised. Industry is limited to small food processing facilities.

The region is semi-developed logistically, with some paved main supply routes at lower elevations, and some passable dirt roads and trails in higher aspects.

BACKGROUND - HISTORY OF CONFLICT IN NAGORNO-KARABAKH:

The Nagorno-Karabakh has a history defined by conflict between Armenians and Azerbaijanis. Foreign intervention by Turkey, Russia, and the former Soviet Union has also played a significant role.

After a series of conflicts in the late 1800s and early twentieth century, Nagorno-Karabakh, which was occupied primarily by Armenians, was administratively placed under the control of Azerbaijan by the Soviet Union after the Russian Revolution. This ultimately led to Armenians in Nagorno-Karabakh seeking to secede from Azerbaijan. The First Nagorno-Karabakh War began in February of 1988. It ended in May of 1994 with almost all of the region breaking away from Azerbaijani control into the hands of Armenia. Upwards of 25,000 reportedly died and an unknown number were displaced. There was never a signed peace treaty. Low-level violence erupted in the ensuing decades.

2020 NAGORNO-KARABAKH WAR - OVERVIEW:

The 2020 Nagorno-Karabakh War began on 27 September 2020 and lasted 44 days. Azerbaijan, backed by Turkey, conducted a well-integrated combined arms campaign that included UAS, manned airpower, artillery, missiles, and rockets in addition to infantry maneuver and mechanized capabilities. Based on open source review, UAS integration was the key synergizing factor in Azerbaijan's victory over Armenia, the forces of which surrendered after Azerbaijan took the important town of Shusha.

An armistice, brokered primarily by Russia, was signed on 9 November 2020 with hostilities formally ceasing on 10 November. UAS was not a standalone "silver bullet" in Azerbaijan's victory. The success evolved due to long-term investing in modern equipment and training, financially supported by oil and gas revenue. This investment focused on UAS, including platforms for ISR, loitering munitions, and UCAV, and most importantly, the detailed integration of UAS into their combined arms capability. NOTE: While the Nagorno-Karabakh War could have escalated beyond the territory's geographic boundary into a much larger conflict between Azerbaijan and Armenia, it never progressed to this level. Azerbaijani warfighting prowess and tactical and operational successes, due in great measure to their effective UAS integration, played a key role in this. Strategic influence by Russia and Turkey may also have had a role, but of much less consequence than their UAS-synergized combined arms campaign.



Locations (red circles) of significant engagements between Azerbaijani and Armenian forces in the 2020 Nagorno-Karabakh War. Map by Ed Darack.

2020 NAGORNO-KARABAKH WAR - UAS EMPLOYMENT BY AZERBAIJAN - OVERVIEW:

Based on analysis of open source data and information, the critical synergizing component of Azerbaijan's success in the war was their detailed integration of UAS into a well-orchestrated and highly-synchronized combined arms campaign. The synergy this integration engendered was due to UAS employment in a number of roles, including: ISR, targeting, interdiction, strike, SEAD, forward observation, armed reconnaissance, SCAR, BDA, IO collections, and possibly EW. Azerbaijan employed a variety of UAS platforms, of a variety of types, including those primarily used as ISR collections platforms, loitering munitions, and UCAV. Apparently, according to available open source data and information, the Azerbaijanis used UAS in all engagements of the conflict, in standalone, supported, or supporting roles. Azerbaijan's success demonstrated that a force of relatively inexpensive unmanned aircraft can tremendously synergize lethality when employed with detailed integration in a combined arms construct. Azerbaijani UAS, both directly and indirectly in support, was responsible for rendering combat ineffective: 4,000+ Armenian troops (KIA), 146 tanks, 29 infantry fighting vehicles, 138 towed artillery pieces, 12 radar systems, 2 manned aircraft, 5 UAVs, 300 trucks and support vehicles, 18 self-propelled artillery units, 72 multiple rocket launchers, 29 surface-to-air missile systems, and 3 electronic warfare systems, among other battlespace effects. Armenian and Azerbaijani maneuver elements rarely came in contact with one another, with most tactical effects generated by indirect fires and UAS. Armenia reportedly sustained 7 times the losses of Azerbaijan.

UNMANNED AIRCRAFT OPERATED BY AZERBAIJAN:

Azerbaijan procured a number of unmanned aircraft systems prior to the Nagorno-Karabakh War. The following is a list of the most salient. Numbers are estimates. Azerbaijan also likely used commercial / improvised small UAS (e.g. DJI) at the tactical level.

PLATFORM	MANUFACTURER / ORIGIN COUNTRY	UAS TYPE / PAYLOADS	DOD GROUP / MGTOW	NUMBER PROCURED & DATE	NAGORNO-KARABAKH USE & NOTES
Aerostar	Aeronautics Defense Systems Israel	Multi-role, primarily ISR Variety: EW, communications, etc.	Group 3 507 lbs	14 2007-2012	Unknown use in Nagorno-Karabakh. If used, was likely for collections, possible targeting, FO, IO collections
Hermes 450	Elbit Systems Israel	Multi-role, primarily ISR Variety: EW, communications, etc.	Group 3 1,212 lbs	10 2008-2013	Unknown use in Nagorno-Karabakh. If used, was likely for collections, possible targeting, FO, IO collections
Heron	Israel Aerospace Systems Israel	Multi-role, primarily ISR Variety: EW, communications, etc.	Group 5 2,535 lbs	5 2011-2013	Unknown use in Nagorno-Karabakh. If used, was likely for collections, possible targeting, FO, IO collections
Searcher II	Israel Aerospace Systems Israel	Multi-role, primarily ISR Variety: EW, communications, etc.	Group 3 1,100 lbs	5 2011-2013	Possible use in Nagorno-Karabakh. Collections, possible targeting, FO, IO collections, BDA
Harop (Harpy II)	Israel Aerospace Systems Israel	Multi-mode loitering munition optimized for SEAD. 35 or 51 pound warhead	Group 3 298 lbs	50 2014-2016	Used in Nagorno-Karabakh. Attack, SEAD, anti-radar, anti-EW, anti-armor, ISR, FO, IO collections, BDA / low RCS
Orbiter 3	Aeronautics Defense Systems Israel	Multi-INT, ISR, Targeting	Group 3 66 lbs	10 2016-2017	Used in Nagorno-Karabakh. Collections, possible targeting, FO, IO collections, BDA / low RCS
Orbiter 1K	Aeronautics Defense Systems Israel	Loitering munition. 2.2 to 6.6 lbs warhead	Group 2 28.6 lbs	80 2016-2019	Used in Nagorno-Karabakh. Attack, ISR, IO collections, FO, BDA / low RCS
SkyStriker	Elbit Systems Israel	Loitering munition. 11 to 22 lbs warhead	Group 3	100 2016-2019	Used in Nagorno-Karabakh. Attack, ISR, IO collections, FO, BDA
Hermes 900	Elbit Systems Israel	Multi-role, primarily ISR Variety: EW, communications, etc.	Group 5 2,425 lbs	15 2017-2018	Used in Nagorno-Karabakh. Collections, communications relay, possible EW, possible targeting, FO, IO collections, BDA
Bayraktar TB2	Baykar Turkey	Multi-role UCAV, weapons platform, multi-INT, comm, ISRT, EW	Group 5 1,430 lbs	Units procured unknown June 2020	Used in Nagorno-Karabakh. Attack, SEAD, SCAR, possible CAS, ISR, FO, IO collections, possible EW, BDA. Four hardpoints for PGMs

Chart by Ed Darack

MANNED AIRCRAFT RETROFITTED FOR UAS USE BY AZERBAIJAN:

Azerbaijan employed at least one type of manned aircraft that they modified for unmanned use in the Nagorno-Karabakh War, the Antonov An-2. The An-2 is a single-engine utility biplane produced by the Soviet Union beginning in 1946. Azerbaijan employed roughly 60 modified Antonov An-2 aircraft in the Nagorno-Karabakh War, using them as loitering munitions and for unmanned ISR (IMINT) and NTISR (drawing fire to determine location of Armenian troops).

ARMENIAN CAPABILITIES:

While Armenia has worked to modernize its forces in recent decades, their base capabilities are generally inferior to those of Azerbaijan. Supported by oil and gas revenues, Azerbaijan has outspent, and more importantly, spent more wisely and intelligently, than Armenia. More importantly, Armenia's ability to integrate their base capabilities and conduct an effective combined arms campaign is inferior to that of Azerbaijan, as demonstrated during the course of the 2020 Nagorno-Karabakh War.

At the opening of the 2020 Nagorno-Karabakh War, Armenia's capabilities consisted of: artillery, tanks, MLRS, tactical ballistic missile systems, armored personnel carriers, tactical fixed-wing aircraft, attack and general utility rotary-wing aircraft, air and ground transport craft, infantry and infantry support weapon systems, EW capabilities, and UAS.

Like Azerbaijan, Armenia invested in UAS in the years leading up to the 2020 Nagorno-Karabakh War. However, this investment has proven to have provided far fewer returns of far less value than that of Azerbaijan. Armenia reportedly possesses the Russian-made Orlan-10 UAS, with ISR and EW capabilities. Armenia also produces its own UAS, the Krunk (Crane) series, the Baze (Base), the Azniv, and the X-55. These are fixed-wing systems used for ISR (primarily IMINT) and all but the X-55 are Group 1 UAS. The X-55, which is based on the Russian Ptero-5E, is a Group 2 system. Armenia has produced one known loitering munition, the HRESH, but it has proven relatively ineffective. Additionally, the Armenian company UAV LAB LLC has reportedly produced roughly four Group 1 multirotor and fixed-wing tactical ISR UAS.

Armenian air defense and EW systems were quickly rendered inoperable by the Azerbaijanis in the earliest days of the conflict. These air defense systems were inadequate in defending against the UAS component of the combined arms campaign waged by the Azerbaijanis and were successfully targeted - by the UAVs against which they proved incapable of interdicting. These systems include the low-altitude surface-to-air missile system 9K33 Osa, a Soviet-era system with technology dating to the 1960s; the short-range SAM system 9K35 Strela-10, a Soviet system with technology dating to the 1970s; the medium-altitude, medium-range 2K11 Krug, a Soviet system with technology dating to the mid 1960s; the 2K12 Kub, a medium-altitude surface-to-air missile system of Soviet origin with technology dating to the late 1960s; the Tor M2KM low- to medium-altitude SAM system of Soviet origin with technology dating to the mid 1980s; the 9K37 Buk medium range SAM system of Soviet origin with technology dating to the late 1970s; and the S-300 long-range SAM system of Soviet origin with technology dating to the late 1970s. They also possess the Russian-made Polye-21 EW system with technology dating to 2010. Some sources claim that Armenia also uses the Krasukha EW system. Built by Russia, with technology dating to 2014, this is a very robust system.

AZERBAIJANI AND ARMENIAN UAS USE PRIOR TO THE 2020 NAGORNO-KARABAKH WAR:

Azerbaijani and Armenian use of UAS against each other during low intensity conflicts dates back at least to 2012. Notably, Azerbaijan and Armenia used UAS against one another in a low intensity conflict in April of 2016. Armenia achieved virtually no known significant effects, while Azerbaijan, using Israeli-sourced UAS, including Harop loitering munitions, achieved limited tactical goals. These included rendering combat ineffective three Armenian tanks, and, reportedly, a battalion COC. Notably, Azerbaijan, during the April, 2016 conflict, integrated ISR UAS into their combined arms campaign by using them to identify targets and then to generate precision mensurated coordinates for anti-tank guided missile systems and artillery to engage these targets.

In July of 2020, just prior to the opening of the 2020 Nagorno-Karabakh War, Armenian and Azerbaijani forces engaged one another along the northern reaches of their shared border. The most notable outcome of these engagements was Armenia's use of the Russian-made Polye-21 EW system to down and capture a number of Azerbaijani Israeli-produced UAVs, including Hermes 900, SkyStriker, Orbiter 3, and Harop loitering munitions.

AZERBAIJANI UAS IN THE 2020 NAGORNO-KARABAKH WAR:

Azerbaijan's tactical and operational successes with detailed integration of UAS in their combined arms framework resulted from years of investment, use, and refinement of unmanned technology, TTPs, and training, including manned-unmanned teaming TTPs. Much of their capabilities likely coalesced and synergized within the months leading up to the 27 September opening of the conflict, notably after the July 2020 engagements with Armenia. Another key element to their capabilities—arguably the most important pillar of their success—is the involvement of Turkey. Turkey manufactures one of their key unmanned platforms, the Bayraktar TB2, a UCAV. Furthermore, Turkey has recent extensive operational experience with UAS, notably the TB2, in Syria and in Libya. They also, reportedly, provided some financing to Azerbaijan for them to purchase the systems. Reputable open source information reveals that Turkish personnel may have not just helped train the Azerbaijanis, but were involved directly in planning and in operations of the systems during the war. This may have been the case not only with UAS, but also with other components. Commercial satellite imagery identified at least two Turkish F-16s based in Azerbaijan near Nagorno-Karabakh during the war.

Azerbaijani UAS capabilities provided enhanced situational awareness with optimized signature. Many have low signature at the platform level due to the small relative size of the UAVs (Armenia's antiquated radar and air defense systems helped provide Azerbaijan a status of UAV air supremacy), and at the tactical level due to effective manned-unmanned teaming that allowed the Azerbaijanis to remain outside the Armenian's effective precision fires weapons engagement zone while searching for, PIDing, and engaging Armenian targets, both stationary and fixed. From outside the WEZ, the Azerbaijanis were able to maintain their SA at high levels, including that required to generate precision mensurated coordinates for their engagement systems. Furthermore, Azerbaijani use of UAS led to the complex, compartmentalized nature of the battlespace being a force multiplier for them—Armenia's forces were constrained and funneled by non-permissive terrain into restrictive postures upon which the Azerbaijanis, through UAS manned-unmanned teaming, were able to find, fix, track, target, and then engage them with precision, by loitering munitions, UCAV-released munitions, manned aircraft, artillery, mortars, MLRS, and other indirect fires. The Azerbaijanis were able to assess effects on targets through UAS feed, and then adjust fires accordingly, if necessary. Concurrently, UAS provided a continuous feed of IO base material.

With this aggressive, UAS-synergized posture, the complex, compartmentalized battlespace proved to be an ally to the Azerbaijanis as they were able to maneuver into locations ideal for signature optimization while pressing the fight to the enemy through manned-unmanned teaming. The Azerbaijanis operated throughout the battlespace in a highly-networked distributed manner and leveraged manned-unmanned teaming with UAS, this teaming an integral part of their combined arms architecture, to dominate the enemy throughout the mountainous battlespace, arguably the most difficult of environments in which to compete.



Frame captures of a video released by the Ministry of Defense of Azerbaijan that shows the engagement of an Armenian Army 122mm 2A18 (D-30) towed howitzer by an Azerbaijani UAS and subsequent overflight (upper left in right image) of an Azerbaijani *Orbiter 1K* (Aeronautics Defense Systems - Israel). Note in left image impact crater, and then strike on right image. This indicates apparent forward observation and fires adjustment. Feed was subsequently processed for the Azerbaijani IO campaign. Credit: Ministry of Defense of Azerbaijan (four images).



Another example of remote fires adjustment. Notice impacts near the gun emplacement on left, and then effects on target on right. This is an exceptional example of incorporating manned-unmanned teaming with UAS into a combined arms framework, enhancing SA while optimizing tactical signature.

AZERBAIJANI UAS IN THE 2020 NAGORNO-KARABAKH WAR (CONTINUED):

Detailed analysis of open source information reveals that Azerbaijan employed UAS in a number of key roles and mission sets, some of which overlapped, with a multitude of some being performed by an individual platform on a single flight:

ISR:

Unknown when ISR collections specific to Azerbaijan's initiation of the war began, but likely prior to 27 September during Phase 0 Shaping. Most of this ISR came in the form of IMINT, although it is possible that some of their systems, notably the Bayraktar TB2, conducted SIGINT collections. The Azerbaijanis maintained continuous ISR coverage throughout the war. Some of this feed was used for their comprehensive IO campaign.

NTISR:

Azerbaijan's retrofitted Antonov An-2 performed a small number of roles. Remotely controlled and laden with high explosives and video cameras with transmitters, they served to draw out Armenian troops to fire upon them as they approached (they leveraged the large RCS and overall substantial signature). Remote operators were able to then find, fix, track, and target Armenian positions. The An-2 biplanes at that point acted as loitering munitions, engaging the targets. A total of roughly 60 of these aircraft were placed into service by Azerbaijan during the 2020 Nagorno-Karabakh War.

SEAD, INCLUSIVE OF ANTI-EW:

One of Azerbaijan's critical early initiatives that was highly synergized by UAS was the suppression of Armenia's Air Defenses. All types of Azerbaijan's UAS played a role in SEAD, including their ISR platforms, loitering munitions, and their Bayraktar TB2 UCAV. Even the re-purposed Antonov An-2 biplane was used for SEAD.

Azerbaijani UAS platforms acted as forward observation capabilities for fires adjustments for artillery and other indirect fires against Armenian air defense platforms, playing a key direct or indirect role in every step of the kill chain, from finding the target, to generating precision mensurated coordinates, to assessing effects. Loitering Munitions struck a number of Armenia's air defense platforms, often in concert with other loitering munitions or ISR platforms for BDA. The Bayraktar TB2 UCAV engaged Armenian air defenses directly (it can carry any of a suite of munitions on its four hardpoints, including guided missiles and rockets), and possibly indirectly with manned aircraft or other TB2s to laser designate targets ("buddy lasing"). Retrofitted Antonov An-2 aircraft, laden with explosives, reportedly were guided onto air defense targets upon being fired upon by those targets. In July of 2020, Armenia proved that its most lethal anti-UAV air defense system was its Poly-21 EW system; Azerbaijani UAS rendered three of these platforms combat ineffective.

With Armenia's air defenses defeated early in the war, Azerbaijan's myriad UAS were able to operate with little or no resistance at all, a state of "UAS air supremacy."

NOTE: It is important to take into consideration Armenia's lack of a robust, modern air defense network in the efficacy of Azerbaijan's UAS-synergized combined arms campaign. A competitor with an air defense network comprising such components as more powerful and more numerous radars, C-RAM systems, and more tightly integrated SAM capability (like Israel's "Iron Dome") may have precluded such a swift victory as Azerbaijan experienced, or precluded a victory at all. One of the most important considerations for UAS integration into a combined arms campaign is the robustness of a competitor's air defense network, and then training and developing technology and TTPs for the defeat of such a system. Clearly, the Azerbaijanis did just that, as evidenced by their swift dismantling of Armenia's air defenses.

FORWARD OBSERVATION AND FIRES ADJUSTMENT:

One of the most important roles that Azerbaijan demonstrated UAS to be able to perform in an integrated combined arms campaign is forward observation and fires adjustment for both fixed and moving targets. Forward observation of fires and fires adjustment by UAS is a salient example of the synergy achievable by manned-unmanned teaming, where unmanned systems find, fix, track, and then provide precision mensurated coordinates or laser designation for manned indirect fires platforms located rearward. Once these fires platforms engage, the forward UAS can be used to provide imagery data to determine effects on the target, and then provide fires adjustment data if necessary. There are numerous examples of this UAS role in Azerbaijan's combined arms campaign against Armenia.

STRIKE:

Undertaken concurrently with SEAD, UAS was used early in the campaign to strike pre-determined Armenian targets, both moving and fixed, throughout Nagorno-Karabakh, notably logistical capabilities deep in the rear. Strike was then conducted throughout the remainder of the war, as circumstances allowed. Strike was undertaken by loitering munitions as well as the Bayraktar TB2 UCAV.

AZERBAIJANI UAS IN THE 2020 NAGORNO-KARABAKH WAR (CONTINUED):

ARMED RECONNAISSANCE:

Undertaken by the Bayraktar TB2 UCAV and loitering munitions, armed reconnaissance proved to be a viable role undertaken by UAS, notably due to the loiter time of the Bayraktar TB2. The TB2 allowed operators to find targets (both fixed and moving), engage them, and then assess effects from one system. With loitering munitions, another system was required for the BDA task.

SCAR:

Azerbaijan demonstrated that strike coordination and reconnaissance can be conducted by UAS. On multiple occasions, operators of Bayraktar TB2 UCAVs were able to identify a target (both fixed and moving), track it, find other targets within the specific area of the initial target, and then coordinate engagements of all targets with multiple UCAVs, loitering munitions, and indirect fires, then conduct battle damage assessment concurrent to ongoing reconnaissance, and then re-engage if necessary. This unmanned SCAR, or “USCAR,” is arguably the most advanced and complex mission set yet undertaken by UAS.

BDA:

Conducted as part of the kill chain or as general ISR, BDA data proved invaluable to Azerbaijan during the evolving conflict. BDA information was used for determining target effects, and to evolve TTPs, notably flight profiles, integration, and weaponizing practices.

IO COLLECTIONS:

IO played a tremendously valuable strategic component of the war for Azerbaijan. Images and video, posted to internet sites and on television and other media, created a potent narrative for the Armenians that they could not optimize their signature relative to Azerbaijani UAS—that they would be found and engaged with effects. Using UAS for IO collections was clearly a key component of Azerbaijan’s combined arms campaign and overall war strategy from the start.

AZERBAIJAN UAS PLATFORM FOCUS - BAYRAKTAR TB2 UCAV AND THE MAM-L LASER-GUIDED BOMB:

The Bayraktar TB2, developed and manufactured by Baykar of Turkey, performed every type of noted UAS role for Azerbaijan during the 2020 Nagorno-Karabakh War. Using the MAM-L laser-guided bomb, the TB2 proved tremendously capable. Acquired by Azerbaijan in June of 2020, the TB2 has an endurance of 27 hours, four hardpoints, and engaged both static and moving targets.



Moving Armenian MT-LB with Zastava M55 anti-aircraft gun targeted and engaged by an Azerbaijani Bayraktar TB2 UCAV.

Moving Armenian KAMAZ targeted and engaged by an Azerbaijani Bayraktar TB2 UCAV Credit: Ministry of Defense of Azerbaijan (Both).

A MAM-L mounted on a hardpoint on a Bayraktar TB2 UCAV (left) and being dropped at altitude (right). The MAM (Smart Micro Munition) -L, carried exclusively by the Bayraktar TB2, was heavily used by Azerbaijan during the 2020 Nagorno-Karabakh War. The MAM-L has a diameter of 6.3 inches, a length of 3.3 feet, and weighs a total of 48.5 pounds. It can carry a thermobaric, HE, or a dual warhead for use against reactive armor. The native MAM-L is guided with a laser designator and has a range of 5 miles. A modified version retrofits it as a coordinate seeking weapon with INS/GPS guidance and has a range of up to 8.7 miles. The system can be used against stationary or moving targets (laser designated). Credit: Baykar.

AZERBAIJANI UAS EMPLOYMENT - KEY POINTS FROM THE 2020 NAGORNO-KARABAKH WAR:

Azerbaijani employment of UAS demonstrated a number of critical concepts regarding: detailed integration of UAS into a combined arms architecture, manned-unmanned teaming, unmanned systems and tactical and operational signature, and unmanned systems and enhancement of situational awareness at the tactical and operational levels with passive and active mechanisms.

DETAILED INTEGRATION:

The detailed integration of UAS into their combined arms structure proved tremendously synergizing. Furthermore, Azerbaijan's effective manned-unmanned teaming, notably demonstrated by forward observation and fires adjustment, was yet further synergizing to the overall capability of their campaign. The 2020 Nagorno-Karabakh war dramatically illustrated how the integration of UAS and manned-unmanned teaming will shape the evolving nature of capabilities, including those of U.S. and ally forces and all competitors, asymmetric, near-peer, and peer throughout the world. Detailed integration of UAS into a combined arms framework with a focus on manned-unmanned teaming is a tremendous force multiplier, and will allow non-state actors to wage ever more lethal campaigns and also further propel the capabilities of potential near-peer and peer adversaries of the United States. The detailed integration of UAS by the Azerbaijanis allowed them to dominate the battlespace in a networked, distributed manner in complex, compartmentalized terrain while maintaining optimized tactical and operational signature.

MANNED-UNMANNED TEAMING:

The rapidly evolving concept of manned-unmanned teaming is critical, as demonstrated by Azerbaijan's UAS employment in the war. A focus on manned-unmanned teaming set the stage for the successful, complex task of adjusting fires with real time BDA. This is a critical component of the evolving realm of integration of UAS into a combined arms environment. The manned-unmanned teaming sub-framework allows for ever more complex missions to be undertaken by developing ever more detailed and refined TTPs along with enabling technology. Training plays a huge role in this, both for preparation against potential adversaries who embrace the manned-unmanned teaming concept, as well as for the development of endemic technology and TTPs for operational use. Manned-unmanned teaming has dramatically evolved from the basic passive role of a human operator simply compiling remotely-sensed imagery data to the capabilities demonstrated by Azerbaijan during the war, where active roles were undertaken, remotely, including targeting, BDA, and adjustment of fires.

SIGNATURE OPTIMIZATION:

The use of UAS allowed the Azerbaijanis to perform a number of warfighting tasks with extremely low signature at the tactical and operational levels, with operators and manned capabilities (such as artillery) far in the rear, away from Armenian sensors and engagement capabilities, well outside of their precision fires weapons engagement zone. Furthermore, the physical size and hence low RCS of individual UAV platforms employed by Azerbaijan further optimized their signature at the tactical level.

SITUATIONAL AWARENESS:

The ultimate foundation of combat efficacy and lethality, situational awareness has proven to have been dramatically enhanced at the tactical and operational levels through the detailed integration of UAS in a combined arms campaign with a focus on manned-unmanned teaming. This SA enhancement comes from both passive systems and active systems. Passive systems include providing high-resolution imagery for targeting, and generating precision mensurated coordinates. Active systems include laser designating targets. Azerbaijan demonstrated that they have a tremendous level of SA at the tactical level, with the ability to repeatedly strike, with effects, relatively small targets such as howitzers, vehicles, and small infantry units withUCAV-launched munitions, loitering munitions, or by using indirect fires using UAS-generated targeting.



Dramatic example of the accuracy achievable from modern UAS. This howitzer was targeted and engaged by a Bayraktar TB2 UCAV using a MAM-L laser-guided bomb. The howitzer is deeply entrenched in a well fortified position. Credit: Ministry of Defense of Azerbaijan.

RELEVANCE OF UAS EMPLOYMENT BY AJERBAIJAN IN THE 2020 NAGORNO-KARABAKH WAR:

With Joint Force focus on potential near-peer and peer competitors including China, Russia, North Korea, and Iran, while ever vigilant for asymmetric, non-state, and international criminal activity, the key takeaways from Azerbaijan's UAS employment in the 2020 Nagorno-Karabakh War are eminently, and critically, relevant for Joint Force evolution. Unmanned systems use, notably unmanned systems incorporated into a combined arms construct with detailed integration with an emphasis on manned-unmanned teaming, will clearly define the evolution of combat for the foreseeable future. Maintaining a lead in this will require intensive focus of effort, to include careful, detailed research and development of systems, TTPs, and of course, training. Azerbaijan's employment of UAS in the 2020 Nagorno-Karabakh War stands as the key salient exemplary demonstration today of not just what unmanned system integration and teaming can deliver, but how it may evolve, for both the Joint Force as well as potential competitors.

China has demonstrated that it has made great strides and clearly seeks to make unmanned systems, their integration, and teaming a key pillar of their national military strategy. Russia also is pursuing ever-greater capabilities, and notably is a leader in counter- and anti-unmanned systems with their EW capabilities. Iran poses threats with unmanned systems directly with its organic systems and indirectly with the export of them to non-state actors such as Hamas.

By using Azerbaijani UAS employment in the 2020 Nagorno-Karabakh War as a base to create unmanned capabilities simulations and for exercise design, training parties will be able to face demonstrated, proven threats. Notably, incorporating simulations for force-on-force training, for ADFOR TTPs, and for EXFOR TTPs, will work to propel capabilities necessary as outlined by current doctrine and Joint Force outlook. Furthermore, this will engender the further development of unmanned systems technology and TTPs for operational use as training exercises may serve the added function of research and development arenas.

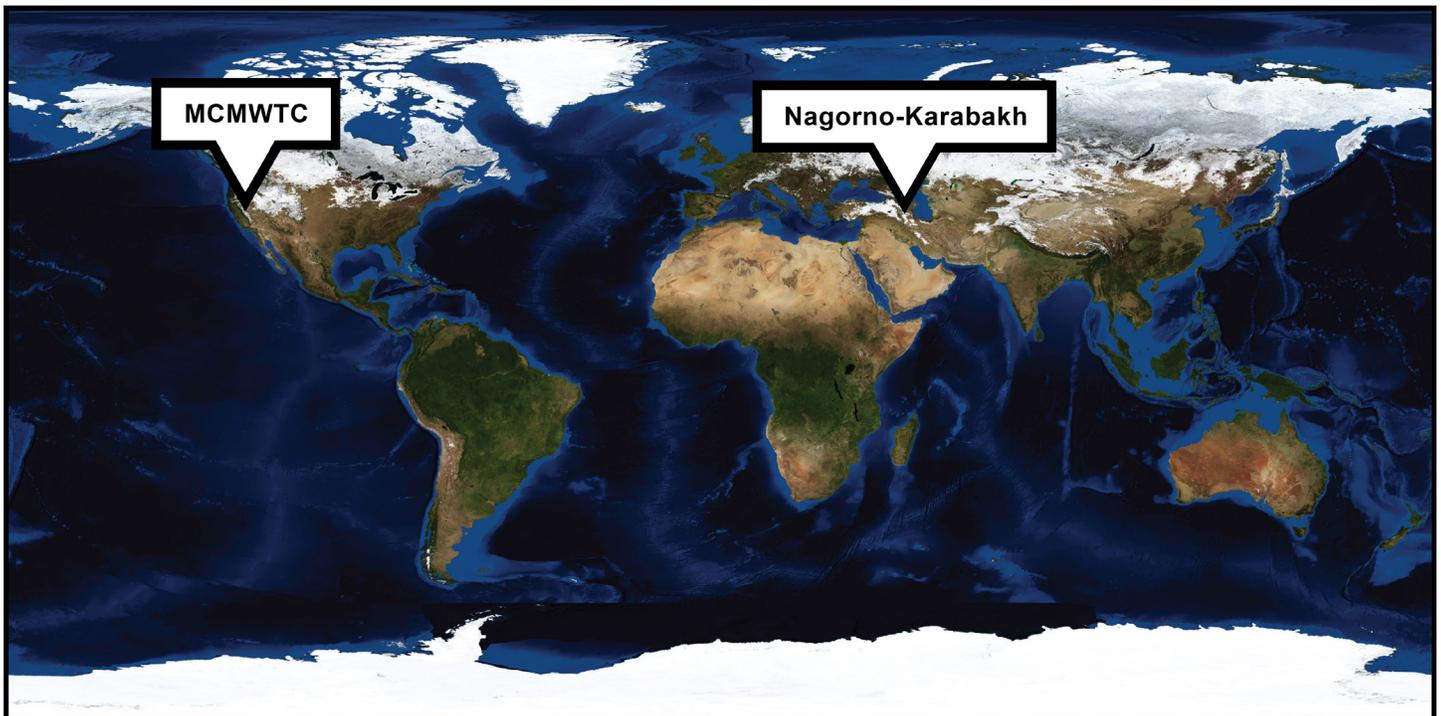
What was witnessed with the 2020 Nagorno-Karabakh War was a real-world embodiment of what military theorists and force structure designers have postulated for years: that a force composed of small units working in a distributed-but-networked nature utilizing unmanned systems incorporated into a combined arms structure with detailed integration can dominate the battlespace, of any environment, and this includes dominating legacy systems such as air defense systems, armor, and manned aircraft.

All of these evolutionary goals and concepts are distinctly identified in recent Department of Defense publications, including: National Security Strategy, National Defense Strategy, National Military Strategy, Commandant's Planning Guidance, Marine Corps Force Design 2030, and the Department of the Navy Unmanned Campaign Framework.

This is a tremendous opportunity for Joint Force evolution.

MARINE CORPS MOUNTAIN WARFARE TRAINING CENTER:

The Marine Corps Mountain Warfare Training Center, with its physiographic similarities (including terrain type, climate, and altitude range) to the location of key engagements of the 2020 Nagorno-Karabakh War, is ideally suited to host training that incorporates key takeaways and simulations of UAS integration and manned-unmanned teaming demonstrated by Azerbaijan.



The Nagorno-Karabakh region and the Marine Corps Mountain Warfare Training Center both lie at approximately the same latitude, and have similar physiography and climates. Map by Ed Darack.

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MARINE CORPS MOUNTAIN WARFARE TRAINING CENTER (CONTINUED):



The Marine Corps Mountain Warfare Training Center. Photographs by Ed Darack

MARINE CORPS MOUNTAIN WARFARE TRAINING CENTER (CONTINUED):

Darack Research unmanned systems were designed to function in all environments, notably high mountain realms. Furthermore, training simulations and training simulation systems are an integral component of the Darack Research portfolio of innovations. The Darack Research UAV-1 and the Darack Research UAV-2, group 1 multi-rotor UAS, can each deploy a wide variety of simulators, notably the “TPAIS” or terminal phase, attacking ingress simulator. Upon release, these either fall to the ground, slowed by a ribbon, or glide along a trajectory, simulating the terminal phase of flight of any guided or ballistic weapon system or any combination of weapons employed during an attacking ingress. Furthermore, they incorporate a variety of training effects, including sirens, lights, or a combination. Using a variety of colors and sirens, these simulators may represent virtually any type of weapon system, from HE, to chemical, to cyber, and they can represent a UAV-released weapon, a loitering munition, UAV “swarms,” or any type of direct or indirect fire, from artillery to railgun projectiles. With Darack Research systems deployed during MCMWTC training evolutions, all types of missions Azerbaijan conducted, to include the simulation of indirect fires, and more, can be replicated. Furthermore, a broad variety of novel technology and TTPs may be created through this process. Due to the austere nature of the terrain and conditions at MCMWTC, training evolutions innovated here, as well as technology and TTPs developed to work here, will be readily adaptable for training venues of any other type of environment, including littoral, desert, and jungle, all of which are more permissive to unmanned systems. “What works at Bridgeport will work anywhere.”

Darack Research is also working on the UAV-3, a fixed-wing UAS that can simulate loitering munitions.



UAV-1 at MWTC EAF



TPAIS at MWTC EAF



UAV-2, with snowshoes, at MWTC



UAV-2 and UAV-1 at MWTC EAF



Darack Research simulated UAV “swarm” / Ed Darack (all photos)

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