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Techno-Geopolitics and the Turkish Way of Drone Warfare

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EXECUTIVE SUMMARY

Contrary to the African proverb "speak softly but carry a big stick," Turkish strategic culture tends to speak loudly, carry a big stick—and sometimes use that very big stick after a brief talk. With Turkey's burgeoning drone-warfare edge, enabled by the nation's rising defense industries, unmanned aerial systems have become a very big stick for the Turkish military. While these assets are not magical wands to address all threats across the spectrum, the Turkish way of drone warfare has introduced various innovative concepts of operations, which have visibly paid off in a broad frontier including Libya, Syria, and Karabakh. Of particular importance to NATO, and resembling the Arab-Israeli wars of the Cold War era, Turkey's robotic-warfare solutions have proven to be effective against Soviet-Russian weaponry in the hands of the Armenian occupation formations in Nagorno-Karabakh, as well as the Syrian Arab Army deployments in the northern plains of Syria. Finally, the combat-tested arms have enabled new horizons for the Turkish defense technological and industrial base in high-tech exports. Turkey craftily uses its exports clientele to build geopolitical bounds.

This report first analyzes the techno-geopolitics of the Turkish way of drone warfare. Subsequently, it assesses the foundations of Turkey's defense-exports strategy in the international weapons market. Finally, the last section outlays the key trends to monitor in Turkey's "dronization" roadmap.

TECHNO-GEOPOLITICS OF THE TURKISH WAY OF DRONE WARFARE

Turkey's military capabilities can be matched by those of only a few NATO militaries and, notably, only by the United States for drone-warfare capacity.[1] Although a large number of articles have focused on the technical aspects of Turkey's rapid dronization, few, if any, have correctly touched upon the geopolitical ramifications of this robotic-warfare breakthrough.

In Turkey's case, growing drone-warfare capacity is a military phenomenon with immense geopolitical resonation. Above all, the rising robotization of An-

1 Richard Outzen, "Deals, Drones, and National Will: The New Era in Turkish Power Projection," Washington Institute for Near East Policy, July 2021, https://www.washingtoninstitute.org/policy-analysis/deals-drones-and-national-will-new-era-turkish-power-projection.

kara's strategic options allows the Turkish administration to act more boldly beyond borders. Interestingly enough, while the toolbox seems to be new, the geostrategic paradigm is decades old, as explained below.

Traditionally, the Turkish strategic culture has been centered on the active exercise of military power when needed. Doctrinized back in the 1990s, Turkey's national security policy was built on two pillars, the "active deterrence" (*aktif caydırıcılık*) National Military Strategic Concept (*Milli Askeri Stratejik Konsept*), along with the "Two-and-a-Half War" (*İki buçuk savaş*) military-geostrategic paradigm.

These two pillars complemented one another. While the former advocated military-backed coercive diplomacy to address regional challenges, the latter—which was first openly voiced by veteran ambassador Şükrü Elekdağ's paper, published by the Turkish Foreign Office Strategic Research Center's periodical in 1996—stated that the Turkish Armed Forces should develop high combat readiness to fight two conventional wars, while running a low-intensity-conflict campaign to tackle Kurdistan Workers' Party (PKK) terrorism both at home and beyond borders.[2] In the 1990s, this combination paved the way for the Turkish cross-border incursions into northern Iraq, as well as the maximum pressure on Hafez al-Assad's Baath tyranny in Syria, eventually leading to the exodus of the terrorist organization's leader, Abdullah Ocalan, and manifesting the military victory against the PKK.

From a *realpolitik* viewpoint, at present, Turkey's new drone edge has amplified the Turkish elite's abovementioned strategic thinking by rendering the "military guidebook" less casualty prone, more surgical, less burdensome on defense economics, and less reliant on foreign assistance. Overall, both the active-deterrence concept and the "Two-and-a-Half War" geostrategic paradigm are there to stay in the 2020s—only this time, these concepts are "dronized."

The dronization has equipped Ankara with more *marge de manoeuvre* when opting for military options. Operation Spring Shield in 2020, for example, was centered on the unmanned aerial systems (UAS). The campaign destroyed a large proportion of the Syrian Arab Army's northern deployments, without fielding bulky combat formations in the hostile Syrian territory.

ROBOTIC WARFARE AND TURKEY'S MILITARY-TECHNOLOGICAL TRENDS

The change in Turkey's defense technological and industrial base is profound, and the trend goes well beyond unmanned aerial systems. For some time, Turkey has been developing a robotic-warfare capacity with innovative concepts of operations (CONOPS) and smart weaponry. The dronization of the Turkish military is not limited to aerial platforms.

In the naval segment, Turkey's burgeoning defense industry comes with two interesting solutions. Turkey introduced its first unmanned surface vessel (USV), ULAQ, in February 2021. A joint production of Meteksan and Ares Shipyard, the Turkish Navy's new robotic platform enjoys an operational range of four hundred kilometers and a maximum speed of sixty-five kilometers per hour (kph). The prototype was showcased with a combat payload of Roketsan-made UMTAS and Cirit guided missiles. The USV took part in the Turkish Navy's large-scale Denizkurdu drills in 2021, marking the first laser-guided missile launch from an unmanned surface combatant.[3] Apart from missile roles, ULAQ is compatible with modular configurations, including mine countermeasures, electronic warfare, and intelligence. The manufacturers stated that the next batch will be a special variant, bringing in antisubmarine-warfare features.[4] According to Turkey's procurement chief, Professor Ismail Demir, more ambitious projects will follow ULAQ, such as swarming unmanned naval platforms and unmanned mini-submarines.[5]

Finally, along with aerial and naval systems, Turkish industries have long been working on producing unmanned land-warfare systems. The Presidency of Defence Industries (SSB in the Turkish abbreviation) has been working on fielding robotic ground systems in light-, medium-, and heavy-platform segments.[6]

TURKEY'S DRONIZED MILITARY BREAKTHROUGH: ESTABLISHING DRONE-AUGMENTED BATTLE NETWORKS

While Turkey's aerial drones sparked debates among the global strategic community, the Turkish way of drone warfare—namely, the CONOPS behind achievements from Libya to Syria to Nagorno-Karabakh—remains a key driver of military progress.

2 Şükrü Elekdağ, "2 ½ War," *Perceptions*, 1996, http://sam.gov.tr/pdf/perceptions/Volume-I/march-may-1996/SukruElekdag.pdf.

3 Tayfun Ozberk, "Turkey Wraps Up 'Largest-Ever Version of Denizkurdu Naval Drill," DefenseNews, June 7, 2021, https://www.defensenews.com/training-sim/2021/06/07/turkey-wraps-up-largest-ever-version-of-denizkurdu-naval-drill/; Mustafa Çalkaya, "Ilk Insansiz Denizalti Savunma Harbi Araci Üretime Hazir," Anadolu Agency, August 20, 2021, https://www.aa.com.tr/tr/bilim-teknoloji/ilk-insansiz-denizalti-savunma-harbi-araci-uretime-hazir/2340936.

4 Ibid.

5 "Denizlerde Ruya Gibi Teknoloji! ULAQ Takimina Insansiz Denizalti Eklenecek," TR Haber, December 23, 2021, https://www.trhaber.com/savunma/denizlerde-ruya-gibi-teknoloji-ulaq-takimina-insansiz-denizalti-h25886.html.

6 "Monthly Bulletin (Aylık İletişim Bülteni)," *Aselsan* 42, 2021, https://www.aselsan.com.tr/ASELSANabulten42v11_1842.pdf.

Winning contemporary wars is about winning the battle networks, and this is the underlying reason behind the Turkish Armed Forces' UAS success. Simply put, in the eyes of Turkish defense planners, drones are not merely targeted killing or "war on terror" assets, but crucial components within a network-centric architecture. This paradigm extends to a wide range of tasks, from anti-armor salvos to the suppression of enemy air defenses.

Briefly, a battle network is a systemic combination of engagement and acquisition sensors, command-and-control (C2) components, platforms, and weaponry, along with data links and other electronic communications linking all the above-mentioned items together. By fostering sensor fusion, the networked architecture enables a particular warfighting concept, widely known as "network-centric warfare," allowing combat platforms to engage targets that they could not otherwise track or detect on their own. Bringing all assets within the same architecture boosts commanders' real-time understanding of the overall situation through a large number of disparate sensors.[7]

Turkey's February 2020 Operation Spring Shield, the punitive campaign that targeted the Syrian Arab Army's northern deployments, as well as the Azerbaijani military fight against the Armenian combat formations in the Second Karabakh War, visibly showcased how the Turkish way of drone warfare has established UAS-augmented battle networks. This warfighting school is particularly effective against adversaries lacking sensor-fusion capabilities.[8]

The first feature of the Turkish way of drone warfare is gaining an edge in information superiority through unmanned systems. Turkey's principal tactical and medium-range/long-endurance (MALE) class drones, Baykar's Bayraktar TB-2 enjoys twenty-seven-hour endurance and Tusas' Anka can fly continuously for up to thirty hours.[9] Both drones are equipped with high-end sensors, allowing persistent loitering over target areas. During Spring Shield and the Second Karabakh War, drone-driven intelligence, surveillance, target acquisition, and reconnaissance (ISTAR) gave a solid boost to land-based fire-support weaponry. Open-source intelligence suggests that, in these campaigns, drones were systematically used to augment friendly artillery and multiple-launch rocket systems (MLRS), fostering their efficiencies against a rich target set.[10] The recent Bayraktar TB-2 and Anka variants use indigenously produced, encrypted data-link systems. Produced by CTech Information Technologies Company, Turkey's UAS are connected to satellite-supported battle networks, along with other combat platforms across all domains.[11]

The abovementioned CONOPS approach also responds to critical writings questioning the efficiency of drone warfare, because the bulk of the killing in Syria and Azerbaijan was not done by UAS, but by long-range land-warfare weaponry.[12] Yet, with and without drone support, artillery is a different beast, as observed in Syria and Karabakh. Furthermore, it is not only the Turks who saw the merits of integrating drones for spotter roles to boost land-based fire-support weaponry. Having digested lessons learned from the Syrian expedition, the Russian Ground Forces now operate their 152-millimeter artillery alongside the Orlan-10 drones for ISTAR missions.[13]

The second feature of the Turkish way of drone warfare is the SEAD (suppression of enemy air defense) tasks executed by unmanned systems. During Operation Spring Shield and the Second Karabakh War, Turkey and Azerbaijan hunted down their adversaries' mobile surface-to-air-missile (SAM) systems with a dazzling operational tempo, particularly in the overture of the conflict. While the Turkish military destroyed eight Pantsir and Buk systems within a week, Azerbaijan, fighting a larger target set, eliminated sixty pieces of Armenian SAM systems—mostly 9K35 Strela-10 and 9K33 OSA—within two weeks.[14] Overall, the Turkish way of drone warfare has introduced "dronized SEAD campaigns"—an important and innovative CONOPS.

The abovementioned SEAD pillar leads the military-scientific discussion to two additional case studies.

The first case is about sending a wave of decoys to be followed by the actual knock-out punchers. The Azerbaijani military, Turkey's natural geopolitical ally, chose an interesting tactic to hunt down the Armenian air defenses. It flew

7 For a comprehensive study, see: John Stillion and Bryan Clark, "What It Takes to Win: Succeeding in 21st Century Battle Network Competition," Center for Strategic and Budgetary Assessments, July 10, 2015, 1–2, https://csbaonline.org/research/publications/what-it-takes-to-win-succeeding-in-21st-century-battle-network-competitions/publication/1.

8 Jack Watling, "The Key to Armenia's Tank Losses: The Sensors, Not the Shooters," RUSI, October 6, 2020, https://rusi.org/explore-our-research/publications/rusi-defence-systems/key-armenias-tank-losses-sensors-not-shooters.

9 "Bayrakter TB2," Baykar, last visited February 10, 2022, https://www.baykartech.com/en/uav/bayraktar-tb2/, "Uzun Havada Kalisli," Tusas, last visited February 10, 2022, https://www.tusas.com/urunler/iha/operatif-stratejik-iha-sistemleri/anka.

10 For a detailed assessment of the OSINT input, see: Can Kasapoglu, "Hard Fighting in The Caucasus: The Azerbaijani Armed Forces' Combat Performance and Military Strategy in the 2020 Nagorno-Karabakh War," Turkish Ministry of Foreign Affairs, Center for Strategic Research (SAM), February 2021, http://sam.gov.tr/pdf/sam-papers/SAM-Papers-No.-18.pdf.

11 "Milli İHA'lar Yerli Uydu Terminaline Kavustu," CTech, October 8, 2020, https://ctech.com.tr/en/media-center/news-announcements/milli-ihalar-yerli-uydu-terminaline-kavustu.

12 Antonio Calcara, et.al. "The Drone Revolution in Military Affairs? A Theoretical and Empirical Assessment," LUISS, 2021, https://www.esteri.it/mae/resource/doc/2021/08/LUISS_Stabilita%20politica%20e%20instabilita%20militare_Implicazioni%20politiche%20delluso%20dei%20droni.pdf.

13 Samuel Cranny-Evans, "Russia Integrates Orlan-10 into 2S5 Formations for Increased Lethality," *Janes*, March 23, 2020, https://www.janes.com/defence-news/news-detail/russia-integrates-orlan-10-into-2s5-formations-for-increased-lethality.

14 Hasan Hiz, "Koral, Siha ve F-16'lar: Rus Yapimi Hava Savunma Sistemlerinin Kabusu Oldular," *Yeni Şafak*, March 4, 2020, https://www.yenisafak.com/dunya/koral-siha-ve-f-16lar-rus-yapimi-hava-savunma-sistemlerinin-kabusu-oldular-3528104; Azerbaijani MOD (@wwwmodgovaz), "Armenian Armed Forces: Military Losses Since September 27," Twitter, October 7, 2020, 6:08 a.m., https://twitter.com/wwwmodgovaz/status/1313798380003434505.

remotely controlled, obsolete propeller-driven platforms as unmanned decoys, and spotted Armenian SAM systems as they took the bait. Then, the Azerbaijani military eliminated the targets with either Turkish Bayraktar TB-2s releasing smart munitions or diving Israeli kamikaze HAROPs.[15]

The second case revolves around the joint-warfighting concept of electronic-warfare (EW) systems and combat UAS. During Operation Spring Shield, the Turkish Armed Forces predominantly used two unmanned assets, Baykar's Bayraktar TB-2 and Tusas' Anka-S. Both platforms flew with Roketsan-made smart munitions, mostly the twenty-two kilogram MAM-L, with an effective range of eight kilometers (which can be extended to some fourteen kilometers with inertial navigation system (INS) and Global Positioning System (GPS) support).[16] In other words, they were operating within the engagement envelopes of the Syrian Arab Army's Russia-manufactured Pantsir short-to-medium-range air defenses, with 20–40-kilometer maximum range depending on the variant.[17] To address the threat, the Turkish military used Aselsan-made Koral EW systems effectively, and "blinded" the Syrian air defenses before the drones came in for the kinetic strikes.[18]

Finally, both Turkey and Azerbaijan used systematic drone strikes to destroy a broad array of land-warfare targets, marking the Turkish way of drone warfare's utility against mechanized, motorized, and armored formations, as well as the fire-support units of the adversary. During Operation Spring Shield, the Turkish Armed Forces reportedly killed 3,136 Syrian Arab Army personnel and accompanying militia, and destroyed forty-seven howitzers, fifty-two multiple-launch rocket systems (MLRS), one hundred and fifty-one main battle tanks, twenty-seven armored combat vehicles, twenty-four armored personnel carriers, twelve antitank weapons, thirty-four armored pick-ups, and four mortars.[19] Likewise, during the Second Karabakh War, the Azerbaijani military destroyed or damaged at least one hundred and fifty-two main battle tanks, thirty-two infantry-fighting vehicles, one hundred and sixty-nine pieces of self-propelled and towed artillery, seventy-five pieces of multiple-launch rocket systems (MLRS), and nine mortars, among other equipment. A substantial proportion of these kills were scored by Turkish and Israeli-made unmanned systems (the latter, in the Azerbaijani case), in addition to other weaponry that were cued by drones on many occasions.[20]

It is not only the platforms and systems, but also the munitions, that brought this success. The Turkish rocket and missile manufacturer Roketsan equipped the Turkish drones with MAM-L and MAM-C smart munitions, which boosted target precision by minimizing the margin of error.[21] The MAM-L, in particular, offered a broad array of solutions against a large target set. The line's variety of warhead configurations remains essential in this respect. MAM-L's tandem charge is designed to destroy land-warfare platforms equipped with reactive armor, while the thermobaric variant is particularly effective against targets deployed in bunkers, as well as close settings and urbanized landscapes. In addition, the high-explosive blast warhead allows it to strike troop concentrations and light-armored platforms accurately and effectively.[22]

Overall, in many militaries around the globe, land-warfare formations enjoy only limited organic capability to detect and defend against aerial threats, especially drones. Without such capabilities, land units remain at risk of continuous surveillance, and the threat of air-ground attacks with high-precision munitions or diving kamikaze drones. Belligerents lacking maneuver short-range air-defense (M-SHORAD) capacity and sensors fusion, in particular, offer suitable targets for drone warfare.[23] With heavier munitions, such as the ninety-kilogram MAM-T of Roketsan, which are certified for higher-class drones like Akinci, Turkey's UAS systems will pose a more destructive threat to the abovementioned target set in the near future.[24]

15 Uzi Rubin, "The Second Nagorno-Karabakh War: A Milestone in Military Affairs," Begin-Sadat Center for Strategic Studies, December 2020, 9, https://besacenter.org/wp-content/uploads/2020/12/184web-no-ital.pdf.

16 "MAM-L: Smart Micro Munition," Roketsan, last visited February 5, 2022, https://www.roketsan.com.tr/en/products/mam-l-smart-micro-munition.

17 "Pantsir S-1," CSIS Missile Threat, last visited February 5, 2022, https://missilethreat.csis.org/defsys/pantsir-s-1/.

18 Hiz, "Koral, Siha ve F-16'lar: Rus Yapimi Hava Savunma Sistemlerinin Kabusu Oldular."

19 Ethem Emre Ozcan and Mahmoud Barakat, "Operation Spring Shield Leaves Mark on Syria in 2020," Anadolu Agency, December 30, 2020, https://www.aa.com.tr/en/middle-east/operation-spring-shield-leaves-mark-on-syria-in-2020/2093154.

20 "The Fight for Nagorno-Karabakh: Documenting Losses on the Sides of Armenia and Azerbaijan," *Oryx*, September 27, 2020, https://www.oryxspioenkop.com/2020/09/the-fight-for-nagorno-karabakh.html.

21 SSB (@SavunmaSanayii), "Kahraman Mehmetcigimizin #BaharKalkaniHarekati'nda kullandigi Turk Savunma Sanayii urunleri," Twitter, March 5, 2020, 6:49 a.m., https://twitter.com/SavunmaSanayii/status/1235547985175556096.

22 "MAM-L."

23 "Army Air and Missile Defense 2028," US Army, 2019, 11–13, https://www.smdc.army.mil/Portals/38/Documents/Publications/Publications/SMDC_0120_AMD-BOOK_Finalv2.pdf.

24 Can Kasapoglu, "Heavily-Armed and Dangerous: The Akinci Drone in the Skies," Anadolu Agency, September 7, 2021, https://www.aa.com.tr/en/analysis/analysis-heavily-armed-and-dangerous-the-akinci-drone-in-the-skies/2357792.

TB2 drone of Turkish drone-maker Baykar is seen at a stand during the first day of SAHA EXPO Defence & Aerospace Exhibition in Istanbul, Turkey, November 10, 2021. REUTERS/Umit Bektas

TURKISH DRONE EXPORTS: STRATEGIC OUTREACH AND DEFENSE ECONOMICS

In order to understand why Turkey is following such aggressive steps, and even "catch 'em all marketing," one has to consider the international UAS market outlook at the time being. Above all, the drone market is rising fast and offering lucrative business opportunities, with a compound annual growth rate (CAGR) between 14–15 percent according to estimates, and is expected to have a market size of about $58 billion by the mid 2020s.[25]

Second, the suppliers' shares are fast reshuffling, and Turkish firms are striving to capitalize on the change. For a long time, Israel has dominated drone exports worldwide, due to the United States' strict arms-sale controls, which restrain US defense giants. Between the late 1990s and 2017, Israeli solutions secured about 60 percent of the market share in this weapons segment, with a rich export clientele.[26] Important players, such as Israel Aerospace Industries and Elbit Systems, have traditionally ranked among the globe's dominant drone makers.[27] Although new actors have entered the market, and Israel is no more the absolute dominant force it once was, the Israeli arms industry is punching above its weight by securing more than $8 billion in arms exports in 2020. Drone sales made up roughly 6 percent of that $8-billion total.[28]

The United States is a different story, and represents the textbook example of the unfulfilled potential of a giant defense technological and industrial base, due to heavy bureaucratic and political restraints. In fact, manufacturers like General Atomics Aeronautical Systems, Northrop Grumman, and Boeing could have easily overwhelmed the weapons market 'in the drone segment' under a favorable arms-export landscape.[29] While the Donald Trump administration opted

25 "Global UAV Drones Market Trajectory & Analytics Report 2022," Businesswire, January 18, 2022, https://www.businesswire.com/news/home/20220118005909/en/Global-UAV-Drones-Market-Trajectory-Analytics-Report-2022---ResearchAndMarkets.com.

26 Elisa Catalono Ewers, et. al, "Drone Proliferation: Policy Choices for the Trump Administration," Center for a New American Security, June 2017, https://drones.cnas.org/wp-content/uploads/2017/06/CNASReport-DroneProliferation-Final.pdf.

27 "10 Best Military Drone Manufacturers in the World, 2021," Fortune Business Insights, July 27, 2021, https://www.fortunebusinessinsights.com/blog/10-best-military-drone-manufacturers-in-the-world-10590.

28 Arie Egozi, "Israeli Industry Pushing Jerusalem to Drop MTCR Drone Export Restrictions," Breaking Defense, September 27, 2021, https://breakingdefense.com/2021/09/israeli-industry-pushing-jerusalem-to-drop-mtcr-drone-export-restrictions.

29 "10 Best Military Drone Manufacturers in the World, 2021."

for a more flexible drone-export policy by reinterpreting the Missile Technology Control Regime (MTCR) framework, it was too little too late, due to other actors' entries to the market—particularly China's lucrative snatches in the Middle East, including the Gulf countries.[30] In the mid-2020s, Beijing is expected to match, and even beat, the United States' 31-percent share in the drone market, thanks to the 18.7-percent CAGR of the Chinese UAS industry.[31] Finally, Russia, the second-largest arms exporter of the world, is a textbook latecomer to the "game of drones," taking only baby steps toward developing an export clientele.[32]

Turkey has traditionally been a net arms importer, and this has only recently started changing with a promising rise in defense exports.[33] Turkey's arms sales earned about $3 billion in 2021, an increase of 40 percent compared to the previous year.[34] The state-owned drone maker Tusaş is in the *DefenseNews* top 100 list, while Baykar makes 85 percent of its overall revenue from its export clientele.[35] Drones constitute a central part of Turkey's export portfolio, as they are sophisticated systems. Anka, Bayraktar TB-2, and Vestel-Karayel have already earned places in the international weapons market, and the latter did so without entering into the Turkish military's service.

Bayraktar TB-2 has been exported to more than thirteen countries, including Poland—the first NATO nation to procure a Turkish drone—Ukraine, Azerbaijan, Morocco, Turkmenistan, Ethiopia, Kyrgyzstan, Niger, Qatar, and Libya.[36] Kazakhstan and Tunisia have purchased Tusas' Anka.[37] Finally, Vestel-Karayel made it to Saudi Arabia's weapons market, and might be exported to Hungary soon.[38] Azerbaijan and Ukraine have already used Turkish drones in combat campaigns—the Second Karabakh War and the antiterrorism operations in Donbass as well as the unfolding Russia-Ukraine war, respectively.

Turkey does not only sell drones in an off-the-shelf fashion. Instead, it sparks drone-warfare ecosystems beyond its borders, and fosters its defense-cooperation portfolio through robotic-warfare transactions. Within this framework, Turkey's drone sales mean more than simply arms-export revenue. They are strategic means of building strategic outreach. The Tunisian deal is a good example. Having started negotiations back in 2019, the North African nation opted for procuring Tusas-manufactured, MALE-class (medium altitude and long endurance) Anka drones. Subsequently, Tunisia fell short of funds and could not afford the acquisition.[39] Seeing the Tunisian market falling, the Turkish administration released a lucrative Export-Import (EXIM) Bank loans for the Tunisian UAS portfolio so that the deal could go through.[40] This was because, after Libya, snatching up yet another entry point to the North African weapons market was the utmost priority for the Turkish defense industry, and it meant far more than the payments.

Turkey's drone breakthrough is also a vector for inserting Turkish military power into the conflicts of the administration's choice. In Libya and Azerbaijan, Turkish robotic solutions played critical roles in tipping the military balance in favor of Turkey's export clientele. Via unmanned aerial-combat systems transactions, the Turkish administration builds strategic bonds with other countries, pursuing an effective "drone diplomacy."[41]

Finally, Ukraine is also a solid example of Turkey building techno-geopolitical ecosystems revolving around drones. While the Russian buildup has been intensifying along the Ukrainian frontier, Turkish President Recep Tayyip Erdogan flew to Kyiv to meet President Volodymyr Zelenksy. Amidst

30 Bradley Bowman, Maj. Jared Thompson, and Ryan Brobst, "China's Surprising Drone Sales in the Middle East," *DefenseNews*, April 23, 2021, https://www.defensenews.com/opinion/2021/04/23/chinas-surprising-drone-sales-in-the-middle-east/.

31 "Global UAV Drones Market Trajectory & Analytics Report 2022," Businesswire, January 18, 2022, https://www.businesswire.com/news/home/20220118005909/en/Global-UAV-Drones-Market-Trajectory-Analytics-Report-2022---ResearchAndMarkets.com.

32 Pieter D. Wezeman et.al., "Trends in International Arms Transfers, 2020," Stockholm International Peace Research Institute, March 2021, https://sipri.org/publications/2021/sipri-fact-sheets/trends-international-arms-transfers-2020.

33 Lucie Béraud-Sudreau, et al., "Emerging Suppliers in the Global Arms Trade," Stockholm International Peace Research Institute, December 2020, https://www.sipri.org/sites/default/files/2020-12/sipriinsight2013_emerging_suppliers.pdf.

34 Sevil Erkus, "NATO, EU States Interested in Export of Turkish Drones: Foreign Minister," *Hurriyet Daily News*, December 5, 2021, https://www.hurriyetdailynews.com/nato-eu-states-interested-in-export-of-turkish-drones-foreign-minister-169863.

35 "Top 100 for 2021," *DefenseNews*, last visited January 31, 2021, https://people.defensenews.com/top-100/; Selçuk Bayraktar (@Selcuk), Baslangictan berti tum projelerini oz kaynagi ile yuruten Baykar, gelirlerinin %85'den fazlasini insansiz savas ucagi MIUS ve Bayraktar TB3 gibi platformlar icin Ar0Ge kaynagi olusturuyor," Twitter, January 23, 2022, 3:59 a.m., https://twitter.com/Selcuk/status/1485190560222785548.

36 "Turkey's Baykar in Talks with 10 Countries for TB2 UCAV Sale," *Daily Sabah*, August 4, 2021, https://www.dailysabah.com/business/defense/turkeys-baykar-in-talks-with-10-countries-for-tb2-ucav-sales. Although official sources have not confirmed it yet, open-source satellite imagery confirms the presence of Bayraktar TB-2s in Ethiopia. "Turkey Expands Combat Drone Sales to Ethiopia, Morocco: Sources," Reuters, October 14, 2021 https://www.dailysabah.com/business/defense/turkey-expands-combat-drone-sales-to-ethiopia-morocco-sources.

37 "Kazakhstan Buys 3 Turkish Aerospace-Made Anka UCAVs: Report," *Daily Sabah*, November 25, 2021, https://www.dailysabah.com/business/defense/kazakhstan-buys-3-turkish-aerospace-made-anka-ucavs-report; "Tunis Takes Delivery of Its First Turkish Armed Drones," Africa Intelligence, October 8, 2021, https://www.africaintelligence.com/north-africa_business/2021/10/08/tunis-takes-delivery-of-its-first-turkish-armed-drones,109697033-bre.

38 Mehmet Yilmaz, "Turkey's Armed Drones Put to Test in Hungary: Report," Anadolu Agency, November 13, 2021, https://www.aa.com.tr/en/europe/turkey-s-armed-drones-put-to-test-in-hungary-report/2419797.

39 "Armed Anka-S Drone Order Cancelled Due to Lack of Funds, Despite Turkish Backing," Africa Intelligence, September 22, 2020, https://www.africaintelligence.com/north-africa_business/2020/09/22/armed-anka-s-drone-order-cancelled-due-to-lack-of-funds-despite-turkish-backing,109608221-art.

40 Güntay Simsek, "Tusas tan Ilk ANKA IHA Ihracati," *Haber Türk*, December 13, 2020, https://www.haberturk.com/yazarlar/guntay-simsek-1019/2901758-tusastan-ilk-anka-iha-ihracati.

41 Elizabeth Gosselin, "Turkey's Modern Way of Doing Foreign Diplomacy," Aspenia Online, November 3, 2021, https://aspeniaonline.it/turkeys-modern-way-of-doing-foreign-policy-drone-diplomacy/.

the Russian pressure on Ukraine, the Turkish president signed co-production deals for Bayraktar TB-2 UAS with his Ukrainian counterpart.[42] In other words, President Erdogan's move was meant to show the resiliency of Turkish arms-sales policy, and—unlike the European suppliers in the global arms market—how immune Turkish solutions are to political fluctuations at times of crisis.

When the war erupted, at the time of writing, the Ukrainian military used Bayraktar TB-2s in several strike settings. One incident was the destruction of a BUK mobile air-defense system.[43] As this paper put in context, lessons learned from Syria, Libya, and Karabakh already suggested the combat effectiveness of Turkish drones against mobile Soviet-Russian air-defense weaponry, especially when they lack networked sensor capacity. It remains to be seen, however, whether other successful kills will follow and turn into a pattern in the course of the war. Another incident, which was tactically more significant, was the Bayraktar TB-2 strike on a convoy of Chechen military formations sent by Vladimir Putin's strongman in the Caucasus, Ramazan Kadirov. The strike took place near Kyiv, and helped prevent the influx of Kadirov's militia into the Ukrainian capital.[44] Apart from these two particular incidents, the Ukraine's military shows tendency to hit Russian logistics with TB2 drones.

THE FUTURE OF TURKISH DRONE TECHNO-GEOPOLITICS

Beyond the strategic and operational aspects of the Turkish way of drone warfare, Turkey's NATO identity is a crucial, and often neglected, pillar of the current geopolitical outlook. After the Turkish unmanned systems' achievements against Moscow's two clients, the Syrian Arab Army and the Armenian occupation formations in Nagorno-Karabakh, it is not a coincidence that Ukraine and Poland have become customers for Turkish robotic-warfare solutions, and the Baltic nations will probably follow suit soon.[45]

Bayraktar TB-2 and Anka drones manifest the achievements of the Turkish defense technological and industrial base, but they are not the peak point of Turkey's dronization and robotic-warfare capacity-building policy. Certain trends are likely to determine the future trajectory of Turkish techno-geopolitics.

The first trend is about more advanced CONOPS via higher-end systems. Akinci of Baykar and Aksungur of Tusas looms large in this respect. Also, the future drone air wing of the TCG Anadolu landing helicopter dock (LHD) is another critical issue that needs to be monitored carefully. If Turkey can manage to operate a permanent, robotic air wing from its principal amphibious assault vessel, this would be a novel development for contemporary drone-warfare trends.

Tusas' Aksungur drone features an interesting payload configuration, which includes sonobuoys and magnetic anomaly detectors, along with synthetic aperture radar/ground-moving-target indicator (SAR/GMTI) sensors, allowing the drone to take part in maritime-patrol and antisubmarine-warfare missions. With some fifty hours of endurance, as showcased during its flight tests, Aksungur offers an impressive loitering time over a large area, without the burden of manned aircraft.[46] Akinci, with its 1.5-ton combat-payload capacity, especially deserves attention with the SOM cruise-missile configuration, with high-precision capabilities and an operational range of some 250 kilometers.[47] This lethal combination would equip the Turkish military with a dronized deep-strike option to hit high-value enemy targets deep in hostile territory.

In the absence of the F-35B option, due to the S-400 strategic SAM systems acquisition, Ankara has chosen an interesting air wing for its forthcoming amphibious-assault vessel, TCG Anadolu (based on the Spanish Juan Carlos-1 baseline). Bayraktar is working on two ambitious projects in this respect: the TB-3 drone with folded wings, and the MIUS, Turkey's first jet-engine UAS.[48] It remains to be seen if the Turkish defense industry can indeed come up with a dronized air wing for the Turkish Navy's crown jewel.

The second trend revolves around Turkey's techno-cooperation network. To advance its drone-warfare technical know-how, Turkey has to build viable military-cooperation models.

Ukraine comes under the spotlight in this respect. Akinci, for example, is powered by the Ivachenko-Progress' AI-450T turboprop engines (the B and C variants of the Akinci UAS line are planned to fly with stronger engines).[49] The Turkish-Ukrainian strategic partnership also extends to a

42 Burak Ege Bekdil, "Turkey and Ukraine to Coproduce TB2 Drones," *DefenseNews,* February 4, 2022, https://www.defensenews.com/global/europe/2022/02/04/turkey-and-ukraine-to-coproduce-tb2-drones/.

43 Ukraine Weapons Tracker (@UAWeapons), "#Ukraine: Footage just released of a 9K37-series (Could be M1-2/M2/M3) Buk SAM TELAR being destroyed by a Ukranian Bayraktar TB2, likely with a MAM-L munition. This occured in Malina, #Zhitomyr and it can be seen there is serious destruction," Twitter, February 27, 2022, 12:32 p.m., https://twitter.com/UAWeapons/status/1498003016082931712.

44 "The Destruction of a Convoy of Chechen Special Forces Near Hostomel on Feb. 26 Officially Confirmed by the President's Office," *Kyiv Independent,* February 27, 2022, https://kyivindependent.com/uncategorized/the-destruction-of-a-convoy-of-chechen-special-forces-near-hostomel-on-feb-26-officially-confirmed-by-the-presidents-office/?__cf_chl_tk=PwxbltnjRQKmV9k39QtGh2mdQW.K7gdtnSjyZQ.Wzvc-1646066561-0-gaNycGzNCD0.

45 "Is Latvia the Next NATO Nation to Order Bayraktar TB2 Drones?" *Defense World,* June 7, 2021, https://www.defenseworld.net/news/29744/Is_Latvia_the_Next_NATO_Nation_to_Order_Bayraktar_TB2_Drones_#.YgTh1N9Bw2w.

46 "Aksungur," Tusas, last visited February 6, 2022, https://www.tusas.com/urunler/iha/yuksek-faydali-yuk-kapasitesi/aksungur#.

47 "SOM-J Missile Fact Sheet," Roketsan, last visited February 17, 2022, https://www.roketsan.com.tr/tr/urunler/som-j-stand-muhimmati.

48 Baykar (@BaykarTech), "#BayraktarTB3 ve #MIUS, #MaviVatan'in guvenligi icin TCG ANADOLU'da birlikte gorev yapacak. #MilliTeknolojiHamlesi," Twitter, July 21, 2021, 4:55 a.m., https://twitter.com/BaykarTech/status/1417785316371537924?ref_src=twsrc%5Etfw%7Ctwcamp%5Etweetembed%7Ctwterm%5E1417785316371537924%7Ctwgr%5E%7Ctwcon%5Es1_&ref_url=https%3A%2F%2Fm5dergi.com%2Fsavunma-haberleri%2Fbayraktar-tb3-ile-mius-tcg-anadoluda-birlikte-gorev-yapacak%2F.

49 Yuri Lapaiev. "The Akinci Drone and Ukrainian-Turkish Defense Cooperation," Jamestown Foundation, February 12, 2020, https://jamestown.org/program/the-akinci-strike-drone-and-ukrainian-turkish-defense-cooperation/.

joint-venture deal, "the 'Black Sea Shield" penned between Baykar and Ukrspetsexport, bringing novel horizons, such as the coproduction of aerospace engines and joint production of missile technologies.[50] As indicated earlier, President Erdogan's February 2022 visit to Kyiv has enabled a broader techno-cooperation portfolio, including ambitious coproduction projects. Similarly, Baykar's technology leader, Selçuk Bayraktar, said that the strategic Akinci drone will also be coproduced in Azerbaijan.[51]

Finally, the last trend to monitor is whether Turkey can make it to the top technology league by producing swarming, intelligent systems. Alpagu and Kargu kamikaze drone linesof Turkey's STM, with smart convolutional machine-learning algorithms and image-processing systems, are the most important systems to monitor in this respect.[52] In May 2019, the head of Turkey's procurement office (SSB), Ismail Demir, posted animated footage on his Twitter, showing fixed-wing Alpagu loitering munitions released by an Akinci UAS, flying as mothership.[53] Thanks to its AESA radar and sophisticated sensors, Akinci can share time-sensitive target-acquisition information with the kamikaze drones that it launches. If realized, such achievements would mean that Turkey has succeeded in building a true robotic-warfare deterrent.

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50 Ibid.

51 "Selcuk Bayraktar Acikladi: Akinci TIHA Azerbaycand'da Uretilecek," Haber.aero, February 8, 2022, https://haber.aero/savunma/selcuk-bayraktar-acikladi-akinci-tiha-azerbaycanda-uretilecek.

52 "Kargu: Rotary Wing Attack UAV," STM, last visited February 6, 2022, https://www.stm.com.tr/en/kargu-autonomous-tactical-multi-rotor-attack-uav.

53 Ismail Demir (@IsmailDemirSSB), "Mili IHA platform larimizdan atilabilen suru vurucu IHA sistemi ve farkli konseptler uzerine calisiyouruz," Twitter, May 26, 2019, 2:10 p.m., https://twitter.com/IsmailDemirSSB/status/1132725606418919426.

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