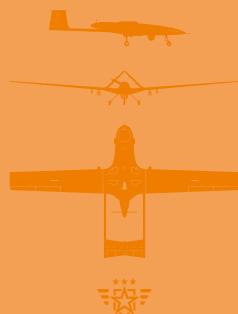


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SUBJECT

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DRONE WARFARE

DRONE WARS, DEFENSE ECONOMICS AND TURKEY'S WAY



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KEY TAKEAWAYS

- Drone warfare is in a reshuffle moment in terms of arms transactions trends and concepts of operations. The number of supplier nations is growing, and the competition in the international weapons market is heated-up. In the meantime, unmanned systems are shifting from predominantly surgical targeting tasks towards assuming warfighting roles in conventional settings, such as spotting for friendly artillery, and eliminating mobile air defenses.
- Unmanned aircraft systems (UAS) are on the rise in the international weapons market with a high compound annual growth rate (CAGR), an increasing trade volume, and a pronounced tendency of militaries to use these assets in armed conflicts. As a result, a growing number of nations are fast gaining an edge in drone warfare. The U.S. & Israel hegemony in exports has been broken by emerging suppliers, such as China and Turkey. As for the loitering munitions (kamikaze drones), especially anti-radiation variants, Israel still has the technological upper-hand and the largest share in the international weapons market. However, various studies categorically distinguished between traditional drones and loitering munitions.
- Although AI-driven opportunities have been on the rise, drone warfare capacity, as it is today, is predominantly reliant on well-trained and disciplined personnel. The present portfolio is still dominated by remotely-piloted solutions.
- From a military-strategic standpoint, and given defense technology opportunities and limitations, underestimating the efficiency of unmanned systems, or considering them to be 'silver bullet' weapons in any engagement against any belligerent, would be equally flawed. Yet, UAS are true force-multipliers, especially when used within the right operational art against adversaries with specific shortfalls.
- Evidence suggests that drone warfare has proven to be very effective against adversaries who lack sufficient sensor fusion capabilities and adequate anti-drone arms deployed in a networked configuration. For example, the Syrian Arab Army during Operation Spring Shield and the Armenian occupation units during the 2nd Karabakh War, with their primarily Soviet-era

armament, inadequate sensor fusion, and lack of information superiority, were ‘suitable preys’ for drones in a conventional setting. In both cases, UAS gave an overall boost to friendly weaponry and platforms, in addition to executing kinetic strikes to eliminate a broad target-set, ranging from mobile air defenses to artillery pieces and armored platforms.

- Maintaining the upper-hand in the electromagnetic spectrum is a critical prerequisite for waging a decisive drone warfare effort. The rate of attrition can be high for unmanned systems, especially when operating within the adversary’s electronic warfare (EW) envelopes.
- Proliferation trends and transactions are accelerating in different corners of the world. Israel has traditionally filled the UAS market with very flexible export conditions and effective systems. In contrast, the United States’ strict arms sales acquis and bulky political-bureaucratic procedures have limited the American manufacturers’ export clientele. China is challenging the Israeli & US hegemony via its growing portfolio. Turkey is yet another rising exporter with a rich buyers’ profile and combat-proven solutions. Russia, finally, remains the late-comer of the unmanned aerial combat vehicles bonanza. Yet, Moscow is diligently investing in interesting solutions, such as the Lancet drone-hunter UAV, while incorporating surveillance drones into artillery units organically for forward observer tasks.
- Although some initiatives strive to rein back drone proliferation trends under regulatory frameworks – especially for lethal autonomous weapon systems (LAWS) –, as visibly observed in the European Union’s stance, defense technology giants and militaries worldwide are heading to the very opposite direction. In this respect, we do not anticipate a particular arms control regime for unmanned systems or autonomous weapons on the horizon.
- Turkey is not only a powerhouse drone producer but also a successful concept of operations developer in robotic warfare. Therefore, lessons learned from Turkey’s drone campaigns are of significant importance.
- Analyzing Turkey’s drone exports without developing a thorough understanding of the global weapons market trends would be analytically inaccurate. One needs to assess the Turkish drone exports policy in comparison to other actors in the game. On the extreme end, Iran provides violent non-state armed groups with its reverse-engineered drones. China actively sells UAS to conflict zones, and in some cases, (for example, General Haftor’s forces in Libya), the ‘end user’ differed from the original importer nation with no objection raised by Beijing. Israel has never been perfectly transparent regarding its exports portfolio, in many cases due to the procurer nations’ sensitive national security demands. Furthermore, unlike the U.S. Congress, the Knesset does not have the final say in Israel’s arms sales decisions. Various drone-maker nations are not Missile Technology Control Regime (MTCR) parties. While the U.S. drone export policy is the strictest, it came at the expense of unfulfilled potential of the nation’s unparalleled defense technological capabilities, costing business opportunities and jobs. As a newcomer in the arms exporters’ league, and given that leading Turkish UAS manufacturers strive to boost their exports revenues, Turkey should not mimic the U.S. acquis in drone sales.

- Turkey needs an aggressive strategy at a time of combat drone market reshuffling. The U.S. defense industry's situation in the Saudi weapons market offers a good example in this respect. Although American arms-producers enjoy a market share of almost 80 percent in Saudi weaponry imports, the Chinese have snatched up the combat drone segment with their recent sales. Beijing is likely to capitalize on its sensational entry into the Middle Eastern market, restricting the space of competition. Market entry and follow-on domination are the two most critical business goals at the time being.
- Introducing a politico-bureaucratic model for Turkey's arms exports roadmap is beyond this report's scope. Nevertheless, we conclude that it would be timely for the Turkish administration to publish an official white paper, explaining Turkey's drone warfare paradigm, defense technological strategy, and exports policy approach. Such a document can serve as a pioneering reference in shaping the ongoing debate about Turkish UAS. Furthermore, establishing a national drone warfare center of excellence with broad participation from the Turkish strategic community (state-owned and private defense sector, security forces, high-tech circles, and relevant think-tanks) would also be a logical next step for Turkey.



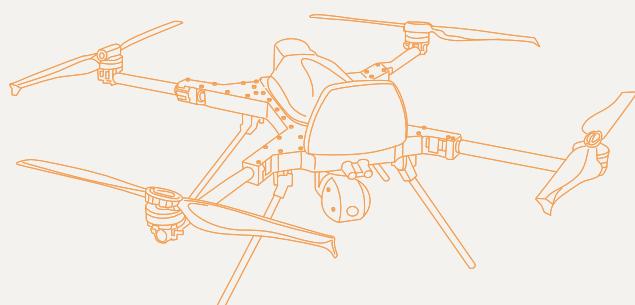
INTRODUCTION

This report analyzes drone warfare concepts, defense technological and industrial base issues and the international weapons market trends. The first chapter explores the role of unmanned aircraft systems (UAS) in modern battle-space.

The second part investigates the current trends in the global UAS transactions, and analyzes the leading drone-exporting countries' defense technological & industrial strategies.

Finally, the third chapter revolves around Turkey. As its indigenous unmanned solutions were frequently used in various fronts such as Libya, Syria, northern Iraq, and Nagorno-Karabakh, the Turkish way of drone warfare attracted particular attention, and made it to headlines. Turkey-manufactured drones are famed for their effectiveness and affordability, along with the Turkish administration's flexible terms in the arms sales business, especially compared to the West. Turkish UAS' successful combat record has also contributed to Turkey's defense exports.

The last chapter explores the Turkish way of drone warfare, and assesses Turkey's present exports roadmap.



DRONE WARFARE

CHAPTER 1: PRELUDE TO THE 'GAME OF DRONES'

Military drones are proliferating fast. Some sources estimate that globally about 100 militaries possess UAS¹. In drone warfare, the sky literally seems to be the limit with emerging configurations and new concepts of operations (CONOPS). This uptrend also signals a transition from the 'war on terror approach' to strategic competition in international weapons market, as well as systematic use of drone warfare in conventional armed conflicts².

Following the 9/11 terror attacks, the U.S.' indigenous drones such as the MQ-9 Reaper and the MQ-1 Predator became vital assets to hit asymmetric adversaries. Other examples followed suit. Nigeria flew Wing Loong II UCAVs against Boko Haram. Likewise, Cairo struck insurgents in Sinai using Chinese drones. In Yemen, the Saudis have resorted to the CH-4 UCAVs to pursue a similar strategy³.

Over time, the role of UAVs in warfighting shifted from counter-terrorism surgical strikes to taking part in higher-scale fighting. As this paper underlines, Turkey's Operation Spring Shield, and Azerbaijan's Second Karabakh War were the milestones in this respect. In addition, UAVs provide unconventional ways of tackling traditional threats via enhancing situational awareness and carrying out time-sensitive precision strikes.

Drone proliferation amongst violent non-state actors is also a significant concern. Their affordability, availability, and simplicity (in terms of operations) make mini-drones critical assets for non-state groups, including terrorists. The PKK network's drone nest in Makhmur, Iraq, is a notable example in this regard⁴. Hamas and Hezbollah also offer important lessons. Both actors use Iran-transferred drones⁵. Moreover, Iran's drones mushroom in Iraq, Lebanon, and Yemen too⁶.

Overall, from inter-state conflict to asymmetric actors, the 'game of drones' has now become the real deal in the town.

UAS have already snatched a significant role in contemporary battlegrounds due to several reasons. First, unmanned systems provide affordable operational intelligence and surveillance, fostering militaries' situational awareness through real-time data flow.

1 Gettinger, Dan. "Weapons of the future: Trends in drone proliferation", Defense News, May 25, 2021, <https://www.defensenews.com/opinion/commentary/2021/05/25/weapons-of-the-future-trends-in-drone-proliferation/>

2 Osborn, Kris. "What Role Will Drones Have In the Competition With China?", November 22, 2021, The National Interest, <https://nationalinterest.org/blog/reboot/what-role-will-drones-have-competition-china-196688>

3 Bruce Einhorn, "Combat Drones Made in China Are Coming to a Conflict Near You", Bloomberg Businessweek, March 17, 2021, <https://www.bloomberg.com/news/articles/2021-03-17/china-s-combat-drones-push-could-spark-a-global-arms-race>, updated on March 18, 2021.

4 Cetiner Cetin, "PKK'nin maket uçak siparişleri", May 25, 2021, Habertürk, <https://www.haberturk.com/yazarlar/cetiner-cetin/3082644-pkk-nin-maket-ucak-siparisleri>

5 Seth J. Frantzman, "Iran's hand seen in Hamas drone threat against Israel - analysis", The Jerusalem Post, May 15, 2021, <https://www.jpost.com/middle-east/iran-news/irans-hand-seen-in-hamas-drone-threat-against-israel-analysis-668110>

6 Sébastien Roblin, "Getting Familiar With Iran's Unmanned Combat Air Vehicles", The National Interest, November 22, 2021, <https://nationalinterest.org/blog/reboot/getting-familiar-iran%E2%80%99s-unmanned-combat-air-vehicles-196691>

Second, they are crucial reconnaissance and precision strike assets in hostile environments. Third, they are effective casualty-minimizing assets⁷. Considering all these features combined, robotic systems will likely assume critical roles in tomorrow's wars. However, one should not forget that UAS are not magical wands that can change everything on their own. For drones to succeed and survive against counter-measures, overtaking the adversary in battle networks and the electromagnetic spectrum remains the utmost priority. The Second Karabakh War showcased that the Armenian formations' lack of sensor fusion was one of the underlying reasons behind their losses in the hands of the Azerbaijani drone warfare campaign⁸. All in all, a platform-centric approach cannot deliver results in the realm of unmanned systems. Network-centric warfare remains a critical edge in this respect.

Besides, despite growing AI opportunities, drone warfare capacity predominantly relies on well-trained and disciplined personnel, as remotely-piloted solutions dominate the international weapons market. In fact, at present, more pilots are trained to fly drones than manned platforms⁹.

And finally, at present and in the anticipated future, unmanned systems cannot replace manned aircraft or SAM systems in the missions portfolio¹⁰. Table 1 below illustrates the capabilities of unmanned aerial vehicles (UAV) compared to multi-role fighters and surface-to-air missile systems.

→ *Table 1:
Capabilities of
Multi-Role Fighters,
Surface-to-Air Defense
systems and UAS.*

Capabilities to be Replaced	Multi-role Fighter	Surface-to-air Defence/GBAD	Unmanned Aerial Vehicle System
Monitoring and protecting territorial integrity	●		
Defensive counter-air	●	●	
Offensive counter-air	●		
Defence Forces' long-range strike capability	●		
Counter-land missions	●		●
Counter-sea missions	●		●
Command and control, intelligence, surveillance and targeting	●		●

Source: Finland Ministry of Defense, June 2015¹¹

7 Prakash Nanda, "Next-Gen Warfare: 4 Reasons Why Combat Drones Are Becoming The Fastest Growing Weaponry In Modern Military's Arsenal", Eurasian Times, November 28, 2021, <https://eurasiantimes.com/next-gen-warfare-4-reasons-why-combat-drones-are-becoming-the-fastest-growing-weaponry-in-modern-militarys-arsenal/>

8 For a detailed work, see: Uzi Rubin, The Second Nagorno-Karabakh War: A Milestone in Military Affairs, BESA Center, 2020.

9 Cholpon Orozbekova and Marc Finaud, Regulating and Limiting the Proliferation of Armed Drones: Norms and Challenges, Geneva Papers, GCSP, 2020, p.8.

10 Finland Ministry of Defense, "Preliminary Assessment for Replacing the Capabilities of the Hornet Fleet: Final Report", June 8, 2015,

https://www.defmin.fi/files/3178/Preliminary_Assessment_for_Replacing_the_Capabilities_of_the_Hornet_Fleet.pdf

11 "Final Report: Preliminary Assessment for Replacing the Capabilities of the Hornet Fleet", Finland Ministry of Defence, June 8, 2015,

<https://www.defmin.fi/files/3182/HX-ENG.pdf>

Currently, around 20 countries are using their drones in some form of armed conflict¹², as UAVs are now becoming true force multipliers for militaries. Resembling the Cold War times witnessing American and Soviet weaponry fighting in the Middle East, third-party conflicts enable comparative analyses of different drone designs and uses under varying conditions. In Libya, for example, Turkish drones and Chinese drones were in rivalry¹³. (There were no drone-on-drone engagements in Libya, nor is Bayraktar TB2 suitable for such missions. However, Turkish and Chinese drones operating in the same battle-space with different belligerents offer valuable lessons as for their combat performances)

There are various countries where Turkish, Israeli, Chinese, and other unmanned aerial solutions compete for a superior position in the market. Ethiopia is a telling example in this respect. The African nation has been in negotiations with Ankara to purchase Turkish drones (and finalized so, according to some press writings). Open-source satellite imagery shows that Chinese Wing Loong and Iranian Mohajer-6 armed UAVs were also stationed in the country's military bases, as seen in Figures 1¹⁴ and 2¹⁵, respectively. In addition, OSINT outlet Oryx claimed that Chinese cargo flights carried TL-2 air-to-surface missiles, which are used in the Wing Loong's combat payload configuration¹⁶.



>>> *Figure 1. A Chinese Wing Loong I UCAV spotted at the Harar Meda airbase on November 2, 2021.*



>>> *Figure 2. Satellite imagery showing a Mohajer-6 Iranian drone stationed at the Semera Air Base.*

12 Brad Howard, "Why demand is surging beyond the U.S. in the multibillion-dollar armed drone market", CNBC News, May 7, 2021, <https://www.cnbc.com/2021/05/07/turkey-and-china-disrupt-the-multibillion-dollar-armed-drone-market-.html>

13 "Libya: UAE Strike Kills 8 Civilians", Human Rights Watch, April 29, 2020, <https://www.hrw.org/node/340983/printable/print>

14 Oryx, "Satellite Images Show Ethiopia's Expanding Drone Buildup", November 17, 2021, <https://www.oryxspionkop.com/2021/11/satellite-images-show-ethiopias.html>

15 PAX, "Ethiopia now confirmed to fly Chinese armed drones", November 18, 2021, <https://paxforpeace.nl/news/blogs/ethiopia-now-confirmed-to-fly-chinese-armed-drones>

16 Oryx, "Ethiopia Acquires Chinese TL-2 Missiles for its Wing Loong I UCAVs", November 10, 2021, <https://www.oryxspionkop.com/2021/11/ethiopia-acquires-chinese-tl-2-missiles.html>

CHAPTER 2:

DRONES AND DEFENSE ECONOMICS

MILITARY DRONE MARKET TRENDS AND DEFENSE ECONOMICS

As more and more countries start to manufacture or operate drones, the future of the global drone industry seems promising. The international military drone market is projected to rise from \$11.25 billion in 2021 to \$26.12 billion in 2028 at a CAGR of 12.78%¹⁸. Some studies even estimate the mid-2020s market size as large as \$58.5 billion¹⁹. Currently, over 100 countries operate various drones²⁰, and forecasts anticipate that this number will grow in the coming years.

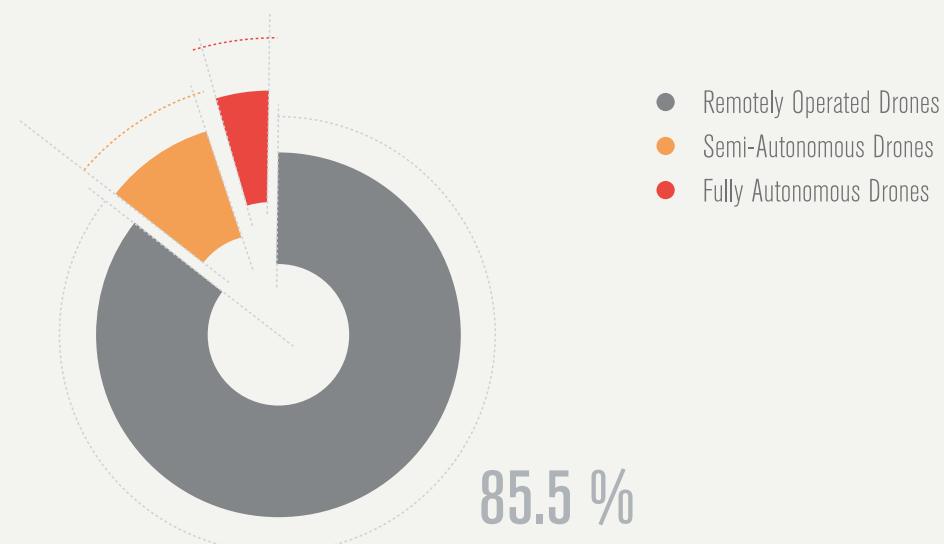
Categorically, fixed-wing platforms are expected to keep the maximum market share²¹. Due to their efficiency, flight speed, and long endurance, such UAVs are becoming increasingly popular among militaries²². As of 2020, 85 percent of the overall drones were remotely-controlled, while only 15 percent of UAVs remain autonomous and semi-autonomous systems, showcasing the predominant technological landscape at the time being²³.

Although the demand for military drones stagnated due to the pandemic (with a 1.40% slower growth rate than usual in 2020), the demand is expected to pick up fast between 2022 and 2028²⁴. Some projections even claimed that by 2030, the global UAV market might reach 70.91 billion USD²⁵, although such an ambitious threshold remains to be seen.

In 2021, the top drone manufacturers were Northrop Grumman, General Atomics, Lockheed Martin, Textron, Boeing, Airbus, IAI, AVIC, CASC, Thales and AeroVironment²⁶. While other companies have seen significant improvements in their market shares, the military drone market and related defense tech leadership have been dominated by Northrop Grumman²⁷. Some other market assessments also include Israel's Elbit Systems amongst the key companies in the military drone segment²⁸.

18 Fortune Business Inside, <https://www.fortunebusinessinsights.com/military-drone-market-102181>, Accessed on: January 31, 2022.
19 Businesswire, <https://www.businesswire.com/news/home/20220118005909/en/Global-UAV-Drones-Market-Trajectory-Analytics-Report-2022---ResearchAndMarkets.com>, Accessed on: February 21, 2022.
20 Brad Howard, "Why demand is surging beyond the U.S. in the multibillion-dollar armed drone market", CNBC News, May 7, 2021, <https://www.cnbc.com/2021/05/07/turkey-and-china-disrupt-the-multibillion-dollar-armed-drone-market-.html>
21 Fortune Business Insights, "Military Drone Market Size, Share & COVID-19 Impact Analysis", July 2021, <https://www.fortunebusinessinsights.com/military-drone-market-102181>
22 AUAV, "Drone Types: Multi-Rotor vs Fixed-Wing vs Single Rotor vs Hybrid Vtol", June 2016, <https://www.auav.com/articles/drone-types/>
23 Fortune Business Insights, "Military Drone Market Size, Share & COVID-19 Impact Analysis", July 2021, <https://www.fortunebusinessinsights.com/military-drone-market-102181>
24 Fortune Business Insights, "Military Drone Market Size, Share & COVID-19 Impact Analysis...", July 2021, <https://www.fortunebusinessinsights.com/military-drone-market-102181>
25 Allied Market Research, "Unmanned Aerial Vehicle (UAV) Market... Global Opportunity Analysis and Industry Forecast, 2021-2030, October 2021, <https://www.alliedmarketresearch.com/unmanned-aerial-vehicle-market-A09059>
26 Market Watch, "Military Drone 2021 - Market Share, Top manufacturers Entry, Globally Market Size and Forecast", Market Watch, November 9, 2021, <https://www.market-watch.com/press-release/military-drone-market-2021---market-share-top-manufacturers-entry-globally-market-size-and-forecast-cagr-of-66-reports-page-no-126-2021-11-09>
27 Ibid.
28 Fortune Business Insights, "Military Drone Market Size, Share & COVID-19 Impact Analysis...", July 2021, <https://www.fortunebusinessinsights.com/military-drone-market-102181>

Global Military Drone Market Share, By Technology, 2020



>>> *Figure 3. As of 2020, remotely-operated systems constitute 85 percent market share, while semi and fully autonomous systems, together, constitute 15 percent. Source: Fortune Business Insight²⁹.*

Intelligence, surveillance, reconnaissance, and target acquisition (ISTAR) needs are still driving the industry, thanks to armed forces' quest for more situational awareness in complex battlegrounds. Strike roles for unmanned systems are also on the rise³⁰.

Israel and the United States have dominated the global military drone industry until recently. Between late 1990s and 2017, Israeli drone exports accounted for roughly 60% of the drone transfers worldwide with a crowded, yet not fully disclosed, exports clientele³¹. At present, Israeli actors Elbit Systems and Israel Aerospace Industries rank among the leading military drone manufacturers around the globe³². Israeli Defense Forces (IDF) mostly use UAS to maintain real-time situational awareness. However, the IDF operate armed drones as well³³.

Israel's flexible, business-friendly acquis, compared to the West, and particularly the U.S., plays a critical role in its drone exports success. According to the Israeli Defense Export Controls Act, the DECA (Defense Exports Control Agency) is the "Competent Authority for export control" on behalf of the Ministry of Defense Director General. The DECA's "Major Programs Licensing Division" manages the UAV transactions³⁴. The Israeli Foreign Ministry participates in the arms sales consultations through the advisory committees³⁵.

²⁹ Ibid.
³⁰ Ibid.

³¹ Elisa Catalano 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>

³² Fortune Business Insights, "10 Best Military Drone Manufacturers in the World, 2021", July 27, 2021, <https://www.fortunebusinessinsights.com/blog/10-best-military-drone-manufacturers-in-the-world-10590>, accessed on November 21, 2021.

³³ RUSI, "Armed Drones in the Middle East: Israel", <https://drones.rusi.org/countries/israel/>

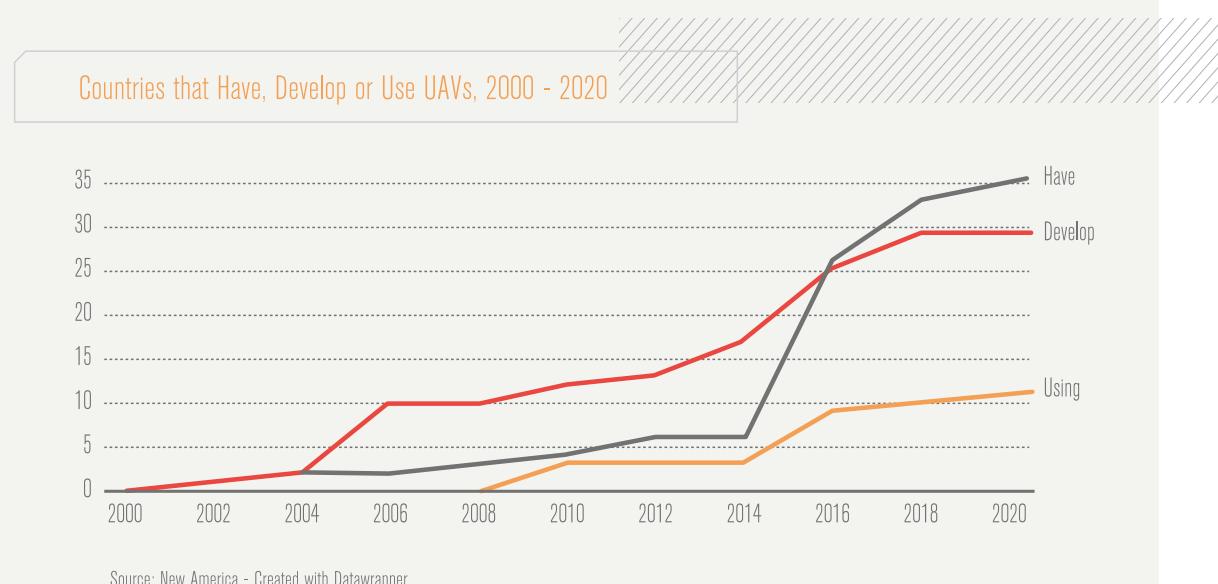
³⁴ For more information, see: <http://www.exportctrl.mod.gov.il/English/Pages/default.aspx>, Accessed on: January 31, 2022.

³⁵ 2007 Arms Exports Control Law, http://www.exportctrl.mod.gov.il/Documents/%D7%97%D7%95%D7%A4%D7%99%D7%A7%D7%95%D7%97%20%D7%A6%D7%95%D7%95%D7%99%D7%9D%20+%20%D7%AA%D7%A7%D7%AO%D7%95%D7%AA/Defense_Export_Control_Law.pdf, Accessed on: January 31, 2022.



With its sophisticated, highly combat-capable solutions, the U.S. is another leading actor alongside Israel. Various American firms, including Northrop Grumman, General Atomics Aeronautical Systems and Boeing, are ranked among the top military drone manufacturers globally³⁶. However, Washington is quite selective in its weaponry exports, namely, in granting drone sales. This is why the American UAV manufacturers face enormous hardships when competing against other exporters, such as Israeli, Turkish, and Chinese firms. Currently, the U.S. holds approximately 31% of the market share. However, by 2030, Beijing is expected to take over Washington, with a burgeoning CAGR of 18.7%³⁷. Overall, the U.S. holds a good stance in the market but American drone sales could have been doing better compared to their current shape.

The U.S.-Israeli domination in the drone industry is now challenged by other countries. The graph below shows that the drones are proliferating fast³⁸. Today, Turkey, China, and recently Russia emerge as alternatives, with the first two nations already being significant drone exporters in the international weapons market.



36 Fortune Business Insights, "10 Best Military Drone Manufacturers in the World, 2021", July 27, 2021, <https://www.fortunebusinessinsights.com/blog/10-best-military-drone-manufacturers-in-the-world-10590>, Accessed on November 21, 2021.

37 Business Wire, "Global UAV Drones Market Trajectory & Analytics Report 2022 - ResearchAndMarkets.com", January 18, 2022, <https://www.businesswire.com/news/home/20220118005909/en/Global-UAV-Drones-Market-Trajectory-Analytics-Report-2022---ResearchAndMarkets.com>

38 Micheal Peck, "China Is A Major Exporter of Combat Drones", The National Interest, September 8, 2021, <https://nationalinterest.org/blog/reboot/china-major-exporter-combat-drones-193246>, Accessed on November 21, 2021.

	COUNTRY	MODEL (S)	ORIGIN	INTROD.	QUANTITY
→	ALGERIA	CH-3	China	2018	2 ⁱ
		CH-4B			5
		Yablon United-40 ⁱⁱ	Domestic production under Emirati ADCOM Systems's license	2018	2+
→	EGYPT	Yablon United-40 ⁱⁱ	UAE China	2015	unknown
		Wing Long I ^{iv}		2016	10+
		Wing Loong II ^v		2018	unknown
→	IRAN	Ababil-3	Domestic	2014	unknown
		Shaed-129		2012	-
		Mohajer-6		2017 - 2018	-
		Fotros		2013	-
→	IRAQ	CH-4B	China	2015	12 ^{vi}
→	ISRAEL	Heron I	Domestic	2006	unknown
		Heron-TP		2009	-
		Hermes 900		2014	-
→	JORDAN	CH-4B	China	2016	6 ^{vi}
→	LIBYA (GNA)	Bayraktar TB2	Turkey	2019	12 ^{vii}
→	LIBYA (LNA)	Wing Long I	Manufactured in China but delivered / operated by the UAE	2016	unknown
		Wing Long II		2018	-
→	MOROCCO	Harfang ^{ix}	France / Israel	2020	3
→	QATAR	Bayraktar TB2	Turkey	2019	6
→	SAUDI ARABIA	CH-4B	China	2014	5
		Wing Loong I		2015 - 2017	15
		Wing Loong II		2017 - 2019	25
→	TUNISIA	Anka S ^x	Turkey	Deal Suspended	6
→	UNITED ARAB EMIRATES	Wing Loong I	China	2017	15
		Wing Loong II ^{xii}		2018	25
		MQ - 9B ^{xiii}	United States	2020	15 - 18

→ Table 2. The UCAV inventory in the Middle East and North Africa ³⁹.

³⁹ Federico Borsari, "The Middle East's Game of Drones: The Race to Lethal UAVs and Its Implications for the Region's Security Landscape", ISPI, January 15, 2021, https://www.ispionline.it/sites/default/files/pubblicazioni/borsari_analisi_26.01.2021.pdf

DRONE WARFARE AND DEFENSE ECONOMICS TRENDS: A CLOSER LOOK INTO TRANSACTIONS AND WEAPONS MARKET

Currently, the Missile Technology Control Regime (MTCR) is the foremost international mechanism that exerts some level of exports control over the UAVs and loitering munitions⁴⁰. However, MTCR is not as binding as other arms control treaties are.

Besides, the MTCR regime is exercised only by a limited number of nations, falling short of producing a global norm. China not being a party to the MTCR, and the Israeli industry's demands not to follow its regulations (even though Israel is not a party, the state policy keeps observing the MTCR requirements in defense exports), remain top obstacles in this respect.

Overall, in the UAV segment, arms export procedures in each country differ significantly, which leads to almost a case-by-case setting for buyers and suppliers. Furthermore, although some writings suggested the Wassenaar Arrangement and the Arms Trade Treaty & UN Register of Conventional Arms to be other bases for limiting drone warfare transactions⁴¹, these frameworks do not cover all major UAS manufacturers, and fall short of introducing adequate verification mechanisms.

The following section summarizes the export priorities and technology trends of major players in the military-grade drones market. The chapter will zoom-in on the Turkish dimension too.

THE U.S.: CHECKS AND BALANCES RESTRAINING PROFITS AND MARKET SHARES

The United States, on the strictest extreme of the military UAS sales frame, pursues a conservative drone export policy⁴². Washington made an opening to increase its exports in recent years, especially under the Trump presidency. However, even this new policy line has not provided U.S. drone-makers with a drastic market share increase, even though they have a clear technological edge. Moreover, Congressional approval remains one of the most challenging phases in securing a procurement deal with the U.S. arms manufacturers, inevitably leading to a thorough political process of decision-making. At the same time, this bureaucratically cautious and complex system augments checks & balances. However, it puts the U.S. defense industries and drone-makers at a disadvantageous position vis-à-vis other competitors, especially at a time of market reshuffling.

40 Missle Technology Control Regime (MTCR), <https://mtcr.info/deutsch-ziele/>, accessed on November 29, 2021.
41 For a comprehensive study, see: Cholpon Orozobekova and Marc Finaud, Regulating and Limiting the Proliferation of Armed Drones: Norms and Challenges, Geneva Papers, GCSP, 2020.
42 Andrea Shalal and Emily Stephenson, "U.S. establishes policy for exports of armed drones", Reuters, February 18, 2015, <https://www.reuters.com/article/us-usa-drones-exports-idUSKBNOLL21720150218>

During the Trump presidency, the U.S. government invoked its national discretion on implementing the Missile Technology Control Regime's (MTCR) 'strong presumption of denial' for transfers of Category I systems. Within this framework, Washington assumed a selected subset of MTCR Category I UAS with max. speed less than 800 kilometers per hour as Category II, while keeping the right to require a case-by-case review to consider all U.S. interests⁴³.

Within the U.S. regulations, drones can be transferred via Direct Commercial Sales (DCS) or Foreign Military Sales (FMS). Third-party use is subjected to Washington's approval. All military UAS exports undergo Department of State assessment. As applicable, they are reviewed under the Conventional Arms Transfers (CAT) Policy and the Department of Defense (DoD)-led assessment regarding technology security. According to the latest acquis, all UAS transfers, including military UAS transfers, are reviewed to be "consistent with U.S. international nonproliferation commitments, including under the MTCR"⁴⁴.

The five primary objectives of the UAS transfers remains unchanged. These are:

- Build new opportunities for U.S. defense companies in the international defense market,
- Improve U.S. partners' access to UAS for counterterrorism missions,
- Build strong bilateral partnerships through defense sales,
- Preserve America's position in the military and defense industry,
- Prevent the proliferation of weapons of mass destruction (WMD) by deterring adversaries⁴⁵.

43 U.S. Department of State, "U.S. Policy on the Export of Unmanned Aerial Systems", Bureau of Political-Military Affairs, <https://2017-2021.state.gov/u-s-policy-on-the-export-of-unmanned-aerial-systems-2/index.html>

44 Ibid.
45 Ibid.

ISRAEL: BREAKING FREE FROM THE MTCR CHAINS?

Israel is yet another significant case in drone warfare and drone warfare assets-related defense economics framework. Having launched its indigenous drone program in 1962, Tel Aviv has been using UAVs for a long time⁴⁶. Several government bodies, such as the Israeli Air Force Drone Training Center and the Israeli Remotely Piloted Aerial System (RPAS) Academy provide training for operators and mission planners. Additionally, they provide technical support and training to foreign military officials within the security cooperation framework⁴⁷. While Israel's arms manufacturers produce several medium-altitude-long-endurance (MALE) UAVs such as the IAI Heron, Israel looms large as a leading actor in the 'loitering munitions / kamikaze drone' segment. These types of drones loiter around the target area for some time, striking it with an explosive warhead carried by the platform itself organically. The Israeli Aerospace Industry (IAI)'s 'Harpy' and 'Harop' lines remain good examples in this respect. Thanks to their effectiveness, precision and low-detectability, loitering munitions are truly effective in combat, especially in suppression of enemy air defenses (SEAD) missions with anti-radiation features⁴⁸. For example, Israeli Harop loitering munitions have been deadly against the Russian-made short-range air defense system Pantsir variants in Syria⁴⁹. The Azerbaijani military also used the Israeli-made kamikaze drones during the 2nd Karabakh War with great success, including S-300 strategic SAM kills.

Until recently, Israeli armed drone exports dominated the international weapons market. By 2018, Israeli drones accounted for roughly 60% of the global UAV exports with a broad buyers list⁵⁰ and with 4.6 billion USD worth of revenues⁵¹. Besides developing its own drone capabilities, Israel is simultaneously working to build operational ties with its exports clientele. In July 2021, Israel conducted its first international UAV drill, which included some Israeli drone clients⁵². The exercise not only allows for an enhanced military relationship between the countries, but it also enables mutual lessons-learned to achieve improved joint operational capability for the Israeli drone technologies⁵³.

Israel plans to expand its drone use to cover all aspects of everyday life. For example, Tel Aviv is currently working on an initiative called the Naama Project, which will establish a national drone network used for commercial and logistical purposes⁵⁴. The Naama will provide a testing ground to see whether Israeli robotic technology can operate effectively without a person in the loop⁵⁵, manifesting the AI challenge ahead.

46 Ministry of Economy and Industry State of Israel, "Israel's Islands of Excellence: Unmanned Aerial Vehicles and Drones", Invest in Israel, 2018, <https://investinisrael.gov.il/HowWeHelp/downloads/UAVs%20and%20Drones.pdf>

47 Sebastian Sprenger, "Israeli Air Force starts training German Heron TP drone pilots", Defense News, January 30, 2019, <https://www.defensenews.com/global/europe/2019/01/29/israeli-air-force-starts-training-german-heron-tp-drone-pilots/>

48 Charlie Gao, "Unmanned Aerial Vehicles May Be the Key to the Future of Warfare", The National Interest, October 23, 2021, <https://nationalinterest.org/blog/reboot/unmanned-aerial-vehicles-may-be-key-future-warfare-195322>

49 Sébastien Roblin, "How Israel Is Putting Its Kamikaze Drones to Use in Syria", The National Interest, April 23, 2021, <https://nationalinterest.org/blog/reboot/how-israel-is-putting-its-kamikaze-drones-to-use-in-syria-183578>

50 Ibid.

51 Gili Cohen, "Israel Is World's Largest Exporter of Drones, Study Finds", Haaretz, January 11, 2018, <https://www.haaretz.com/premium-israel-is-greatest-exporter-of-drones-1.5243373>

52 Seth J. Frantzman, "Israel Marks Milestones in Drone Warfare With Its First International UAV Drill", The National Interest, July 14, 2021, <https://nationalinterest.org/blog/buzz/israel-marks-milestones-drone-warfare-its-first-international-uav-drill%C2%A0-189573>

53 Ibid.

54 Seth J. Frantzman, "Israel Wants to Create a National Drone Network: A Game Changer?", The National Interest, March 22, 2021, <https://nationalinterest.org/blog/buzz/israel-wants-create-national-drone-network-game-changer-180823>

55 Seth J. Frantzman, "Israel Wants to Create a National Drone Network: Game Changer?", The National Interest, March 22, 2021, <https://nationalinterest.org/blog/buzz/israel-wants-create-national-drone-network-game-changer-180823>



Despite the abovementioned, promising tour d'horizon, Israeli UAS' market share is decreasing, and the Israeli drone manufacturers are facing some challenges in the international weapons market⁵⁶. Israeli defense officials are worried, claim that the Missile Technology Control Regime (MTCR) limits the country's drone exports while China and Turkey are rapidly finding new buyers, and aggressively building clientele in the combat drones market⁵⁷. Although it is not a member of the MTCR, Israel has been principally complying with its guidelines due to its unofficial accord with the U.S.⁵⁸. This commitment has been significantly restricting the solutions that Israeli companies can offer to their clients. Wary of falling behind in the market, Israeli defense firms are now pushing to break free of this alignment, even though it might mean souring their relations with Washington. Another reason why the Israelis; want to break free of the control regime is to improve ties with the Arab states in the wake of the Abraham Accords⁵⁹.

56 Arie Egozi, "Israeli Industry Pushing Jerusalem to Drop MTCR Export Restrictions", Breaking Defense, September 27, 2021, [https://breakingdefense.com/2021/09/israeli-industry-pushing-jerusalem-to-drop-mtcr-drone-export-restrictions#](https://breakingdefense.com/2021/09/israeli-industry-pushing-jerusalem-to-drop-mtcr-drone-export-restrictions/#:~:text=2020%20saw%20Israel%20defense%20exports,firms%20would%20like%20to%20see)

57 Arie Egozi, "Israeli Industry Pushing Jerusalem to Drop MTCR Drone Export Regulations", Perry World House, September 27, 2021, <https://global.upenn.edu/perryworldhouse/news/israeli-industry-pushing-jerusalem-drop-mtcr-drone-export-restrictions>

58 Ibid.

59 Ali Arfa, "The Abraham Accords effect: more armed drones in the Middle East", Bulletin of the Atomic Scientists, April 29, 2021, <https://thebulletin.org/2021/04/the-abraham-accords-effect-more-armed-drones-in-the-middle-east/>

CHINA: THE GUERRILLA MARKETER

With a drone export portfolio that includes almost a dozen countries, China is an emerging UAS power in the international weapons market⁶⁰. Some sources state that this breakthrough occurred in the 2014-2018 timeframe, exporting 153 pieces of armed drones to 13 countries⁶¹. According to SIPRI, China sold 220 combat drones to 16 nations by 2021⁶². Beijing's drones are particularly becoming popular in the Middle East, with countries like Egypt, Iraq, United Arab Emirates, Jordan (even though Jordan allegedly tried to sell its CH-4s rather than use them⁶³), and Saudi Arabia among the top clients⁶⁴. Chinese solutions have found themselves a place in some of the region's deadliest conflicts, including the armed conflicts in Yemen and Libya.

The start of the Belt and Road Initiative in 2013 was an excellent opportunity for China to expand its footprint in the Middle East. According to SIPRI, China has become a major arms supplier to the Middle East for the first time between 2016-2020, with astonishing arms transfer volumes skyrocketing by 386% to Saudi Arabia and 169% to the UAE⁶⁵. The burgeoning demand in the defense industry, and the absence of American solutions due to the US' strict arms sales regulations, urge China to pursue an ambitious strategy to position itself as an alternative to the West as a major combat UAS supplier. The Chinese solutions have been used in conflict zones, providing Beijing with a lucrative marketing advantage.

Some analyses argue that China and the Gulf Arab countries will focus on building lasting cooperation in terms of technology transfer and licensed co-production of various defense systems, including unmanned solutions⁶⁶. China's drone customers are becoming more loyal clients over time. After operating the Wing Loong I for some time, the UAE has been the first importer of the Chinese drone Wing Loong II⁶⁷. On a similar note, the Saudis added the CH-4 combat UAV in their inventory; a drone copied after the American MQ-9 Reaper⁶⁸. At present, SIPRI claims that Egypt, Kazakhstan, Pakistan, Saudi Arabia, Uzbekistan, and the United Arab Emirates are amongst the operators of Wing Loong UCAVs⁶⁹. Beijing's UAS have also recently appeared in the European market, marking a new trend. The export of CH-92A to Serbia in June 2020 looms large as the first example in this respect⁷⁰.

60 Atul Chandra, "Why China's armed UAVs are a global export success, and its fighter jets, not so much", Defence Procurement International, November 5, 2021, <https://www.defenceprocurementinternational.com/features/air/china-has-disrupted-the-military-drone-market#:~:text=Chinese%20military%20UAVs,at%20least%2011%20different%20countries>

61 Micheal Peck, "China Is a Major Exporter of Combat Drones", The National Interest, September 8, 2021, <https://nationalinterest.org/blog/reboot/china-major-exporter-combat-drones-193246>

62 Bruce Einhorn, "Combat Drones Made in China Are Coming to a Conflict Near You", Bloomberg Businessweek, March 18, 2021, <https://www.bloomberg.com/news/articles/2021-03-17/chinas-combat-drones-push-could-spark-a-global-arms-race>

63 Garrett Reim, "Jordan military tries to sell 'knock-off' Chinese drones", Flight Global, June 4, 2019, <https://www.flightglobal.com/helicopters/jordan-military-tries-to-sell-off-knock-off-chinese-drones/132985.article>

64 Bradley Bowman, Maj. Jared Thompson and Ryan Brobst. "China's surprising drone sales in the Middle East", Defense News, April 23, 2021, <https://www.defensenews.com/opinion/2021/04/23/chinas-surprising-drone-sales-in-the-middle-east/>

65 Bradley Bowman et al., "China's surprising drone sales in the Middle East", Defense News, April 23, 2021, <https://www.defensenews.com/opinion/2021/04/23/chinas-surprising-drone-sales-in-the-middle-east/>

66 Alvite Ningthoujam, "The Middle East: An Emerging Market for Chinese Arms Exports", The Diplomat, June 25, 2021, <https://thediplomat.com/2021/06/the-middle-east-an-emerging-market-for-chinese-arms-exports/>

67 Bradley Bowman et al., "China's surprising drone sales in the Middle East", Defense News, April 23, 2021, <https://www.defensenews.com/opinion/2021/04/23/chinas-surprising-drone-sales-in-the-middle-east/>

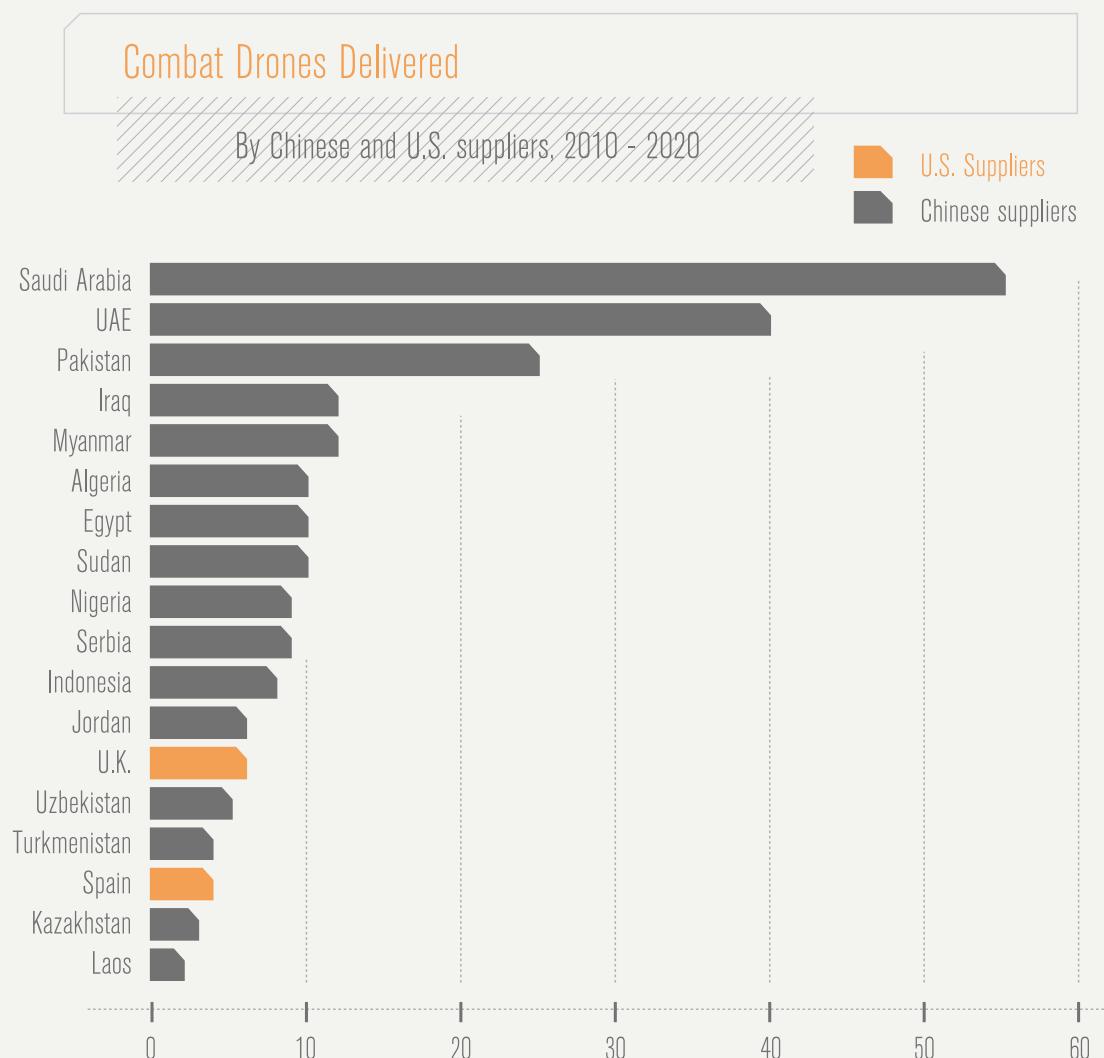
68 Global Security, "Chang Hong-4 (CH-4) Rainbow-4", <https://www.globalsecurity.org/military/world/china/ch-4.htm>

69 April Herlevi, "China as a Niche Arms Exporter", CNA, August 31, 2021, <https://www.cna.org/news/InDepth/2021/08/china-as-a-niche-arms-exporter>

70 Vuk Vuksanovic, "Chinese Drones in Serbian Skies", RUSI, January 5, 2021, <https://rusi.org/explore-our-research/publications/commentary/chinese-drones-serbian-skies>

Overall, the U.S. still might be the leading arms exporter to the Middle East. However, while American defense officials are striving to recalibrate the Conventional Arms Transfer (CAT) policy to secure America's position amongst its Middle Eastern allies, China's footprint in the region is deepening at an alarming pace.

Beijing's export conditions, affordability, and flexible payment terms make Chinese UAS especially attractive. Besides, Beijing is also very adept at reverse engineering to master its drone production lines. According to some Western sources, China allegedly uses downed U.S. drones to inspire its own UAV design and technologies⁷¹.



>>> Figure 5. Combat Drones Sales (includes Chinese and U.S. drone systems)⁷².

71 "China's newest drone appears to be just another copy of American tech", Sofrep, November 8, 2021,
<https://sofrep.com/fightersweep/chinas-newest-drone-appears-to-be-just-another-copy-of-american-tech/>

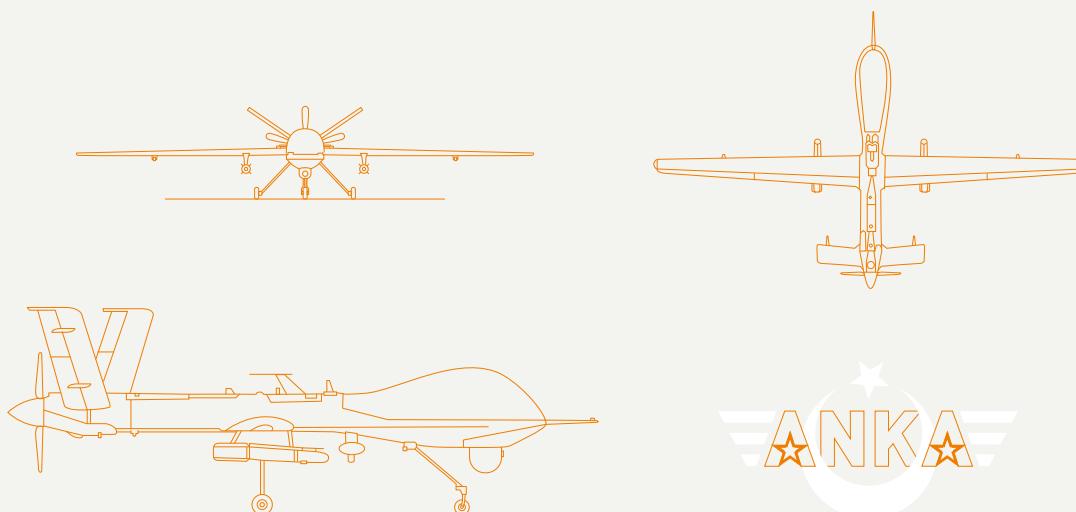
72 Bruce Einhorn, "Combat Drones Made in China are Coming to a Conflict Near You", Bloomberg Businessweek, March 18, 2021,
<https://www.bloomberg.com/news/articles/2021-03-17/china-s-combat-drones-push-could-spark-a-global-arms-race>

RUSSIA: THE LATE-COMER WITH A CENTRALIZED ARMS EXPORTS PORTFOLIO

In Russia, Law No. 227 F.3 of the Federal Constitution issued in 2016 states that arms imports and exports are carried out by legal entities, suppliers aligned with the military-technical cooperation legislation of the Russian Federation⁷³. The most important actor for arms sales is Russia's Rosoboronexport, the country's state agency that facilitates the export and import of all military and dual-use products. It also actively participates in the implementation of the state's military and defense-technological policies, and deals with foreign states in military-technical cooperation framework⁷⁴. At present, Rosoboronexport carries out 85% of Russian arms exports⁷⁵. It also holds the full authority to import and export arms.

Besides Rosoboronexport, 26 other companies and enterprises in Russia have the right to sell military products partially independently. Some of these companies, such as the UAC-Transport Aircraft, United Shipbuilding Corporation and Oboronservis, are only narrowly able to work within pre-approved joint projects with foreign contractors⁷⁶. Russia's joint programs also extend to equipment modernization packages.

Several actors, such as the Instrument Design Bureau, RSK MiG, Sukhoi and the Tactical Missiles Cooperation (KTRV) deal with the procurement of spare parts for weapon systems, provision of various unit services, the maintenance and modernization of military equipment, as well as the training of the technical and the military personnel. The Federal Service for Military-Technical Cooperation sits at the top of the Russian arms export pyramid. It controls and supervises arms exports, issues the licenses of military-technical cooperation, and organizes the demonstrations of military products. Its decision-making is directly tied to the president, who provides the approval for the body's actions.



73 Article 17. Import into the Russian Federation and export from the Russian Federation of weapons and cartridges for it, December 6, 2011, http://www.consultant.ru/document/cons_doc_LAW_12679/4dee7787176d79adce01729fc707095dde896fc/

74 Rosoboronexport, ROC, <https://roe.ru/rosoboronexport/status/>, accessed on November 21, 2021.

75 Finance Rambler, <https://finance.rambler.ru/economics/35789049-chemezov-predstavil-kollektivu-novogo-rukovoditelya-rosoboroneksporta/>, accessed on November 29, 2021.

76 VPK News, "Military export pyramid", October 28, 2013, <https://vpk-news.ru/articles/17986>

Together with the U.S., Russia is the leading arms exporter in the global weapons market⁷⁷. Recently, the pace of Russia's military robotization has accelerated⁷⁸. Moscow strives to differentiate its portfolio with advantageous design features, while struggling to find a place for its more traditional solutions. Russia also recently equipped its Orion reconnaissance drones with combat munitions. This example is noteworthy, as it marked the country's first-fully operational armed drone deployment. Orion's configuration includes 50 kg munitions with a Grad MLRS warhead⁷⁹. The Orlan-10 can also be used in flexible configurations too, such as offering spotter and target acquisition assistance to artillery⁸⁰. In addition, Russia's Tactical Missile Corporation (KTRV) is currently developing more sophisticated guided missile options for other indigenous drones⁸¹.

The late-comer status resonates with Russian solutions' sales in the international weapons market. Although some Russian systems offer good services, the market is already occupied by other drone exporters. So, Russian solutions, which have otherwise made good sales, such as the Orlan-10 with its combat record in Ukraine and Syria, can only find limited space in the industry. Nevertheless, in 2021, Moscow secured a 15 million USD-deal with Myanmar to export Orlan 10-E surveillance drones and Pantsir air defense systems⁸².

Russia also introduced some novel solutions to the market, as illustrated by the Lancet drones and the Sukhoi S-70. The S-70 Okhotnik-B features a sophisticated, 'stealthier' nozzle configuration along with other refinements, which maximize the low-observability of the UAS⁸³. Russian defense officials expect the platform to become operational in 2024⁸⁴. The ZALA Lancet is a loitering munitions line with a range of 40 kilometers. The drone's top speed doubles many other drones, which makes it an essential asset in hunting down other UAS⁸⁵.

77 Peter Suciu, "Is Russia Getting Ready to Buy Combat Drones from Turkey?", The National Interest, May 21, 2021, <https://nationalinterest.org/blog/buzz/russia-getting-ready-buy-combat-drones-turkey-186202>

78 Samuel Bendett, "Strength in Numbers: Russia and the Future of Drone Swarms", Modern War Institute, April 20, 2021, <https://mwi.usma.edu/strength-in-numbers-russia-and-the-future-of-drone-swarms/>

79 Thomas Newdick and Tyler Rogoway, "Russia's Predator-Style Drone With Big Export Potential Has Launched Its First Missiles", The Drive, December 28, 2020, <https://www.thedrive.com/the-war-zone/38446/russias-predator-style-drone-with-big-export-potential-has-launched-its-first-missiles>

80 Samuel Cranny-Evans, "Russia integrates Orlan 10 into 2S5 formations for increased lethality", Jane's, March 23, 2020, <https://www.janes.com/defence-news/news-detail/russia-integrates-orlan-10-into-2s5-formations-for-increased-lethality>

81 Ibid.

82 Prasank Nanda, "Will Russia Be The Next Drone Super-Power As It Starts Exporting Orlan-10E Drones to Myanmar?", Eurasian Times, May 15, 2021, <https://eurasiatimes.com/will-russia-be-next-drone-super-power-as-it-starts-exporting-orlan-10e-drones-to-myanmar/>

83 Thomas Newdick and Tyler Rogoway, "Russia Unveils Stealthier Version Of Its S-70 'Hunter' Unmanned Combat Air Vehicle", The Drive, December 14, 2021, <https://www.thedrive.com/the-war-zone/43504/russia-unveils-stealthier-version-of-its-flying-wing-unmanned-combat-air-vehicle>

84 Alexander Bratersky, "Russia unveils upgraded S-70 Hunter drone, with plans for fielding in 2024", Defense News, December 16, 2021, <https://www.defensenews.com/unmanned/2021/12/16/russia-unveils-upgraded-s-70-hunter-drone-with-plans-for-fielding-in-2024/>

85 Mark Episkopos, "The Flying Kalashnikov: Russia's New Drone Has Ukraine Worried", The National Interest, November 27, 2021, <https://nationalinterest.org/blog/reboot/flying-kalashnikov-russias-new-drone-has-ukraine-worried-196841>

While it is still early to say whether Russia will be another drone power, it has undoubtedly taken the initial significant steps in that direction. In fact, the Russian Ministry of Defense eyes "multi-functional long-range drones to deliver precision strikes that can act in a swarm with manned aircraft, as well as with ground and sea-based robotic systems"⁸⁶. At the time of writing, the Ukrainian battle-space has witnessed Russian robotic aerial systems use - and losses - including Zala KYB kamikaze drones⁸⁷, Orion⁸⁸, and Orlan-10 UAS. It remains to be seen how lessons-learned from the war will shape Russian industrial trends in drone warfare assets manufacturing.

Russia, in a futuristic fashion, is also undertaking important initiatives to develop drone swarms. Some sources claim that "Russian military swarms might soon see the light of day, changing the combat calculus not only for their own forces, but for any who oppose them as well"⁸⁹. Finally, as autonomy will be a determinant in tomorrow's drone warfare technology-geopolitics, Russia needs to step up its AI research and industrial base to develop the fundamental algorithms that can guide combat robots through highly dynamic and uncertain battlegrounds.



86 Samuel Bendett, "Strength in Numbers: Russia and the Future of Drone Swarms", Modern War Institute, April 20, 2021, <https://mwi.usma.edu/strength-in-numbers-russia-and-the-future-of-drone-swarms/>, Accessed on: April 8, 2022.

87 Ukraine Weapons Tracker, <https://twitter.com/UAWeapons/status/1512751317021822983>, Accessed on: April 10, 2022.

88 Ukraine Weapons Tracker, <https://twitter.com/UAWeapons/status/1512566406050631684>, Accessed on: April 10, 022. Samuel Bendett, "Strength in Numbers: Russia and the Future of Drone Swarms", Modern War Institute, April 20, 2021, <https://mwi.usma.edu/strength-in-numbers-russia-and-the-future-of-drone-swarms>

TURKEY'S WAY FORWARD: BUILDING A DRONE EXPORTER PERSONA FOR THE TURKISH DEFENSE INDUSTRIES

As the famous quote goes, "with great power comes great responsibility". Turkey's armed drones have proven to be critical military assets. These systems tipped the military balance in favor of their operator militaries in various conflicts, looming large with Operation Spring Shield and the Second Karabakh War. Besides, Azerbaijan's successful conduct of the 'Turkish way of drone warfare' suggests that Turkey is not only a drone exporter but also a doctrine and CONOPS transferring actor. In past few years, Turkish industrial capabilities have introduced sophisticated weaponry in critical drone-related segments. As highly efficient firepower, such as the SOM cruise missile and MAM-T munitions enter into service, Turkey's drone edge will grow even sharper. Furthermore, more sophisticated platforms, such as Akinci and Aksungur, mark a new era for the Turkish defense technological and industrial base. Besides, Turkish manufacturers also come up with smart loitering munitions, such as the Kargu-2 kamikaze drone, suggesting a promising start in this segment too.

Overall, Turkey has the potential of becoming a top player in the global robotic warfare weaponry market. Thus, the Turkish administration needs to decide whether it wants to be a more flexible arms exporter with lucrative co-production ventures and less bureaucratic restrictions, or a more cautious one with a selective clientele.

The current *acquis* puts Turkey's Ministry of Defense (MoD) at the epicenter of any military-grade exports⁹⁰ (while imports, along with co-production and technology transfer issues are executed via the Ministry of Defense or the Presidency of Defense Industries, the latter currently subject to the U.S.' CAATSA sanctions). The Turkish MoD grants exports licenses, and issues the lists of all materials, systems, and sub-systems that fall under the export controls regulations. The end-user document (*Son Kullanıcı Belgesi*) holds an important place in the legal regulations. Besides, the official wording openly declares the Missile Technology Control Regime and Wassenaar Arrangement to form the basis for any military-related exports from Turkey. When necessary, the MoD can ask for assessments about an exporter from the Turkish intelligence, police department, and the foreign office⁹¹. The explained legal framework applies to Turkey's drone exports as well.

Nevertheless, the missing part in Turkey's drone export policy is not transparency, but the lack of political guidance for bigger questions. What will Turkey say, for instance, should Greece, being a NATO nation, opts for procuring Turkish drones one day? Will the answer be yes, or no, but more importantly, concerning either of the responses, why? Will Turkey be more easy-going and flexible regarding co-production options? Will Ukraine, and Kazakhstan which secured a co-production deal for the Anka drone at the time of writing, constitute exceptions or not.

90 Turkish Ministry of Defense, <https://www.msb.gov.tr/TeknikHizmetler/icerik/savunma-sanayii-guvenligi-ihracat-izni-islemleri>, Accessed on: February 21, 2022; Turkish Legal Acquis on Defense Exports.

91 Ibid.



What about operational sovereignty? Will Turkey certify foreign weaponry to its drones in the future sales, or, to protect Roketsan's unique supplier status, will the smart munitions always remain an off-the-shelf export item? How will Turkey's drone exports policy be towards conflict zones?

There is no right or wrong decision in this respect. Various arms exporters have diverse ways of doing business around the world. Turkish drone exports can follow restrained or more flexible routes. However, the step Turkey takes with respect to drone exports policy will shape its character as a robotic warfare systems exporter nation. On one extreme of the spectrum stands the American example. The U.S. model, revolving around national arms exports regulations, is highly bureaucratic and Congressional, which leads to unfulfilled potential in drone sales. Furthermore, as the U.S.' prime drone-maker General Atomics' leadership has complained time and again, the constrained drone export regulations allow challengers, first and foremost the Chinese, to open space for themselves in the international combat UAS market⁹². The results are bitter for the American UAS industry. The Saudi Arabian weapons market, for example, remains the primary arms importer of American arms, and in the 2016 - 2020 period, accounted for about 25 percent of the U.S. arms exports globally. During the same years, the U.S. weaponry accounted for almost 80 percent of the Saudi imports in total⁹³. Yet, notably, the Saudi drone market is dominated by the Chinese solutions, Wing Loong-2 and CH-4B Rainbow⁹⁴, gifting Beijing with an unprecedented rise in the Gulf country's portfolio⁹⁵.

92 Defensenews, <https://www.defensenews.com/air/2017/08/18/general-atomics-export-restrictions-help-china-grow-its-drone-tech/>, Accessed on: February 19, 2022.
93 For the comprehensive data, see: SIPRI, Trends in Arms Transfers - 2020, March 2021.
94 RUSI, <https://drones.rusi.org/countries/saudi-arabia/>, Accessed on: February 19, 2022.
95 Defensenews, <https://www.defensenews.com/opinion/2021/04/23/chinas-surprising-drone-sales-in-the-middle-east/>, Accessed on: February 19, 2022

We conclude that the American model is not suitable for Turkey for several reasons. Primarily, Washington's restrictive drone exports portfolio has put the U.S. manufacturers in chains in many cases, preventing them to translate their technological edge into revenues. Besides, such a cautious model can only be tolerated by countries like the U.S., which have already established a dominant position in the global weapons markets across the spectrum of advanced weaponry.

Turkey's calculus as a new arms exporter nation differs drastically from the U.S. defense giants, especially in the military-grade drone segment. For one, the national eco-system heavily depends on the foreign weapons markets. The bulk of Turkey's chief private drone-maker Baykar's revenues come from exports. Some firms, like Vestel, have not secured slots in the domestic drone requests.

Second, although the Turkish military, the second largest in the NATO Alliance, is a credible customer for indigenous drone solutions, the domestic market will eventually saturated, or at least, will not pursue large number of orders as the arsenal matures. The saturation will not only affect the private manufacturers but also the state-owned Tusaş. Thus, the export volume will remain key for the sustainability of the Turkish drone industry, as it would mean continued R&D resources and means to attract high-quality talent.

The Chinese model, briefly a laisse faire & laisse passer paradigm of arms exports, stands at the other extreme end. Naval platforms, aircraft (including UAVs), and advanced missiles remain the prime export items of Beijing⁹⁶. Thus, the Chinese have started to export high-tech weaponry, unlike their land vehicles and second-tier missiles dominated portfolio of the past. However, the main problem with Beijing's drone export policy is its lack of sensitivity to the end-user aspect. Especially, the Middle Eastern conflicts, the Libyan Civil War, for example, the Chinese drones were operated by belligerents which were not the licensed end-user of those systems. Even more dangerously, for years, China has kept selling arms to the Iranians, knowing that Iran reverse-engineers those arms and transfers the Chinese weapons to the Lebanese Hezbollah⁹⁷. Such an approach would severely damage Turkey's ties with the West. Second, China has been establishing production lines in nations like Pakistan and Saudi Arabia⁹⁸. The latter also has co-production deals for the Chinese ballistic missiles. So far, Turkey has kept drone co-production options limited to Ukraine, which is a key provider of engines for high-end Turkish UAVs, and to Azerbaijan, which Turkey calls 'two states but one nation', is likely to follow suit. At the time of writing, Kazakhstan, another Turkic state, has secured a co-production deal for the Anka drone of Turkey's Tusaş.

96 April Herlevi, China as a Niche Arms Exporter, CAN, August 2021, <https://www.cna.org/news/InDepth/2021/08/china-as-a-niche-arms-exporter#:~:text=China's%20arms%20exports%20represent%20only,arms%20exports%20remain%20relatively%20modest.>, Accessed on: February 19, 2022.

97 Assaf Orion and Galia Lavi [ed]. Israel-China Relations: Opportunities and Challenges, INSS, 2019, pp.83-85.
98 Israel Defence, <https://www.israeldfense.co.il/en/node/29253>, Accessed on: February 19, 2022.

The Israeli model is an efficient one. For one, the Israeli industries do not fully disclose the exports clientele but stands careful about end-users. Contrary to the American model, there is no need for approval from the Knesset. Thus, Israel's domestic political debates do not constrain drone exports. This isolates the drone export policy from domestic political parliamentary discourse and allows for more technocratic management. Besides, should a buyer nation want to keep the deal undisclosed, it can well be managed this way. The foreign office is involved in the arms sales process at the advisory level, embedded in the commissions under the ministry of defense, which can be appealing for Turkey as well.

Currently, the global weapons market and particularly the drone segment is reshuffling. Apart from the U.S. & Israel axis, the Chinese presence is rapidly growing. Therefore, Turkey has to follow an aggressive export policy to find and build a space for itself. We conclude that, referring to the Israeli model, keeping the Turkish Foreign Office in a commission role when drone exports are destined for an actual or potential conflict zone would be a good addition to the existing mechanisms. Yet, as mentioned earlier, the U.S.' strict export policies with firm Congressional pre-requisites would not allow entering into new markets fast, which is what the Turkish drone-makers need.

Finally, Turkey should issue a white paper that will guide its drone warfare, robotic defense technologies, and drone exports policies. Such a white paper would pioneer the international debate revolving around Turkey's UAS solutions. Besides, it would offer a reference for Turkey's broader defense technological and industrial base, as well as the strategic community.



CHAPTER 3: TURKISH WAY OF DRONE WARFARE

The Turkish Armed Forces remain one of the most ‘dronized’ militaries within the NATO Alliance. As Francis Fukuyama put, with lessons learned from the Syrian, Libyan, and Karabakh theaters, ‘it seems Turkey’s use of drones is going to change the nature of land power in ways that will undermine existing force structures, in the way that the Dreadnaught obsoleted earlier classes of battleships, or the aircraft carrier made battleships themselves obsolete at the beginning of World War II’⁹⁹. More importantly, resembling the Israeli – Arab wars of the Cold War era, Syrian, Libyan, and Karabakh fronts have visibly showcased the superiority of Turkish robotic warfare solutions over the Soviet & Russian-manufactured conventional arms.

Drones have become critical assets in winning wars. The Second Karabakh War has manifested the breakthrough in the making. In Uzi Rubin’s words, the Second Karabakh War was a milestone in military affairs, as it was the first conflict in which unmanned aerial vehicles (UAVs) won a war from the air. Azerbaijan’s UAVs obliterated Armenia’s formidable array of ground-based air defenses, after which they systematically decimated Armenia’s ground force material, including tanks, artillery pieces, and supply trucks. This onslaught forced Armenia to accept a humiliating ceasefire imposed by Russia¹⁰⁰.

FROM OPERATION SPRING SHIELD TO THE SECOND KARABAKH WAR

As Turkey’s drone warfare assets deserve attention, the military success, in fact, was built on the combination of weaponry and concepts of operations (CONOPS). Therefore, this report particularly focuses on Operation Spring Shield and the Second Karabakh War to harvest critical lessons learned.

Operation Spring Shield (February – March 2020) was a punitive cross-border campaign to retaliate to the targeting of a Turkish contingent in Idlib by a Syrian Arab Air Force & Russian Aero-Space Forces joint air-strike, claiming the lives of 36 troops¹⁰¹.

The Spring Shield’s military planning was centered on long-range fire-support weaponry and drone warfare-driven CONOPS. The idea was to run an overwhelming war of attrition to wear down the northwestern buildup of the Syrian Arab Army. The campaign’s operational art prioritized high tempo, an organic integration between land-based fire-support capabilities and unmanned systems¹⁰², casualty-aversion, and systematic surgical strikes.

99 Francis Fukuyama, “Droning on the Middle East”, American Purpose, April 2021, <https://www.americanpurpose.com/blog/fukuyama/droning-on/>, Accessed on: January 24, 2022.
100 Uzi Rubin, The Second Nagorno-Karabakh War: A Milestone in Military Affairs, BESA Center, 2020, p.4.
101 Reuters, <https://uk.reuters.com/article/instant-article/idUSKCN20M2TO>, Accessed on: October 7, 2020.
102 For a demonstration from the campaign, see: <https://www.youtube.com/watch?v=9yIKw2OKK6s>, Accessed on: October 7, 2020.

The Turkish Armed Forces primarily used two principal unmanned aerial systems in the Spring Shield; Bayraktar TB-2 and ANKA-S. Both systems have more than 24-hour endurance (Bayraktar TB-2 some 27 hours¹⁰³, and Anka more than 30 hours¹⁰⁴), meeting a good standard amongst their classes. The long-endurance factor offered adequate loitering time over fixed positions and opportunity target areas, keeping the Turkish offensive's overwhelming pressure intensive at all times. Turkish drone warfare assets had to eliminate a large target set with the incursion. The Syrian Arab Army, along with the Iran-harvested accompanying paramilitary formations, amassed a dense concentration of heavy armor, mobile low-to-medium altitude SAM systems, and artillery along the frontier.

Along with drones, the Turkish smart munitions have also played an equally crucial role, and they constitute indispensable assets within the Turkish way of drone warfare. Roketsan, the chief manufacturer of Turkey's rocket and missile systems, looms large in this respect. During Turkey's Syria expeditions, Turkish drones used Roketsan's MAM-L and MAM-C smart munitions¹⁰⁵, weighing 22 kilograms and 6,5 kilograms, respectively, to fit in limited payload capacities. The primary munitions of choice, MAM-L, comes with versatile solutions against a broad target set with several warhead configurations. Of the MAM-L warhead configurations, the tandem charge is designed to destroy tanks with reactive armor, while the thermobaric variant is effective against closed-settings and bunkers. Lastly, the high-explosive blast warhead option remains optimized for striking troop concentrations and light-armored platforms¹⁰⁶.

Operation Spring Shield was a total success in blitz. Within almost a week, the Turkish military, predominantly drones in kinetic strikes and ISTAR (intelligence, surveillance, target acquisition, and reconnaissance), eliminated some 3,136 Syrian regime manpower, 151 tanks, 47 howitzers, two aircraft (two Syrian Su-24s were hit by Turkish F-16s with beyond-visual-range air-to-air missiles), 8 helicopters, 8 air defense systems, 52 multiple rocket launchers, 12 anti-tank weapons, 24 armored personnel carriers, 27 armored combat vehicles, 34 armored pick-ups and 4 mortars¹⁰⁷.



103 Baykar, <https://baykar.tech/tr/uav/bayraktar-tb2/>, Accessed on: February 21, 2022.

104 Tusaş, <https://www.tusas.com/en/products/uav/operative-strategic-uav-systems/anka>, Accessed on: February 21, 2022.

105 The Presidency for Defense Industries, Official Twitter Account, <https://twitter.com/SavunmaSonayi/status/1235547985175556096>, Accessed on: October 7, 2020.

106 Roketsan, MAM-L, <https://www.roketsan.com.tr/en/product/mam-l-smart-micro-munition/>, Accessed on: October 5, 2020.

107 Anadolu Agency, <https://www.aa.com.tr/en/middle-east/operation-spring-shield-leaves-mark-on-syria-in-2020/2093154>, Accessed on: January 24, 2022.

THE AZERBAIJANI DIMENSION: TURKEY AS A DRONE WARFARE CONOPS PROVIDER

The Second Karabakh War is yet another example of the Turkish way of drone warfare in context. It suggested that Turkey was not only a drone manufacturer and CONOPS builder but also a capacity-transferring country to its natural ally, Azerbaijan. In many ways, the Azerbaijani performance in the autumn 2020 conflict mimicked Turkey's Operation Spring Shield as for the pronounced drone warfare aspects.

The first military-strategic and CONOPS dimension, through which the Azerbaijani Armed Forces followed the footsteps of the Turkish military's Syrian campaign, was the systematic use of unmanned aerial systems (UAS) against the adversary's low-to-mid altitude air defenses at the very outset of the conflict. During the September - October 2020 Nagorno Karabakh campaign, the Azerbaijani Armed Forces eliminated many Armenian 9K33 OSA and 9K35 Strela-10 SAMs by using Turkish and Israeli unmanned aerial solutions. The Azerbaijani military pursued a gradually boosted operational tempo in the initial offensive phase, successfully targeting detected Armenian air defense systems.

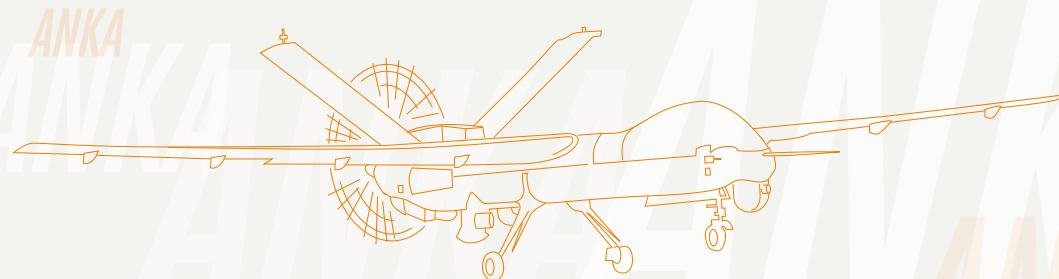


>>> Figure 6. The Azerbaijani Armed Forces targeting an Armenian mobile SAM – appears to be an OSA – by armed drones¹⁰⁸.

On top of the tactical air defense systems, the Azerbaijani military also destroyed Armenian S-300 strategic SAM systems brought to the Nagorno Karabakh frontier by Yerevan following the outbreak of the conflict¹⁰⁹. Using drones in the SEAD (suppression of enemy air defenses) phase was critical.

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Azerbaijani Ministry of Defense, <https://mod.gov.az/az/news/dusmenin-doyus-texnikalari-mehv-edilib-video-32363.html>, Accessed on: October 5, 2020.
Can Kasapoglu and Sine Ozkarashin, The Hunt for Armenia's S-300: Assessing Azerbaijan's Most Sensational Sam System Hit in The Ongoing War, EDAM, October 2020.



Fast elimination of the mobile SAM systems at the outset of the war cut off the Armenian land warfare units from the air defense umbrella. This very shortfall provided Azerbaijan with a window of opportunity to intensify the offensive onto Armenian mechanized and motorized formations, as well as fire-support weaponry, more freely. A similar target acquisition pattern was also visible in Turkey's Operation Spring Shield.

In many engagements, Azerbaijani combat formations employed the Bayraktar TB-2s and Israeli-made loitering munitions (kamikaze drones) to target the Armenian military's land warfare weaponry. Resembling the Syrian Arab Army's almost helpless situation in the face of Turkey's robotic offensive back in early 2020, the Armenian formations in the Caucasus battleground lacked a meaningful anti-drone capacity which remains a key parameter in offensive drone warfare efforts' outcomes.

In the overture of the Second Karabakh War, the Azerbaijani UAS' high operational tempo destroyed more than 40 Armenian main battle tanks (mostly T-72 variants), more than 15 infantry fighting vehicles (IFV) and armored personnel carriers (APC), and more than 30 pieces of multiple-launch rocket systems and artillery systems¹¹⁰.



>>> Figure 7. The Azerbaijani military targeting an Armenian T-72 main battle tank with loitering munitions (kamikaze drone)¹¹¹

110 Oryx, "The Fight For Nagorno-Karabakh: Documenting Losses on The Sides Of Armenia and Azerbaijan", September 27, 2020, <https://www.oryxspionkop.com/2020/09/the-fight-for-nagorno-karabakh.html>, Accessed on: October 5, 2021.

111 <https://postimg.cc/D4dXhTm1>, Accessed on: October 5, 2021.



>>> Figure 8. Azerbaijani drone (probably Turkey-manufactured Bayraktar TB-2), targeting an Armenian multiple-launch rocket system (probably BM-21 Grad) in the Nagorno Karabakh frontier, on September 30, 2020¹¹²

Following the footsteps of the Turkish military's operational art in the Spring Shield, the same year, the Azerbaijani military's heavy land-based fire-support salvos through artillery and MLRS were accompanied by drone warfare efforts in the push for the Armenian-occupied territory¹¹³. The lethal and effective mix of high-precision drone strikes and UAS-augmented overwhelming shelling - with drones in the ISTAR (intelligence, surveillance, target acquisition, and reconnaissance) roles - have visibly paid off in mid-October 2020. Various Armenian defensive positions were abandoned by the troops, leaving a vast number of arms to the Azerbaijani Armed Forces¹¹⁴. The same outcome and pattern were also present in the Syrian Arab Army's case during Operation Spring Shield.



>>> Figure 9. An Azerbaijani MLRS pounding the Armenian defensive line in Nagorno Karabakh, September 30, 2020¹¹⁵

112 Azerbaijani Ministry of Defense, <https://mod.gov.az/az/news/son-saatlarda-dusmenin-daha-sekkiz-doyus-texnikasi-mehv-edildi-video-32452.html>, Accessed on: October 5, 2020.

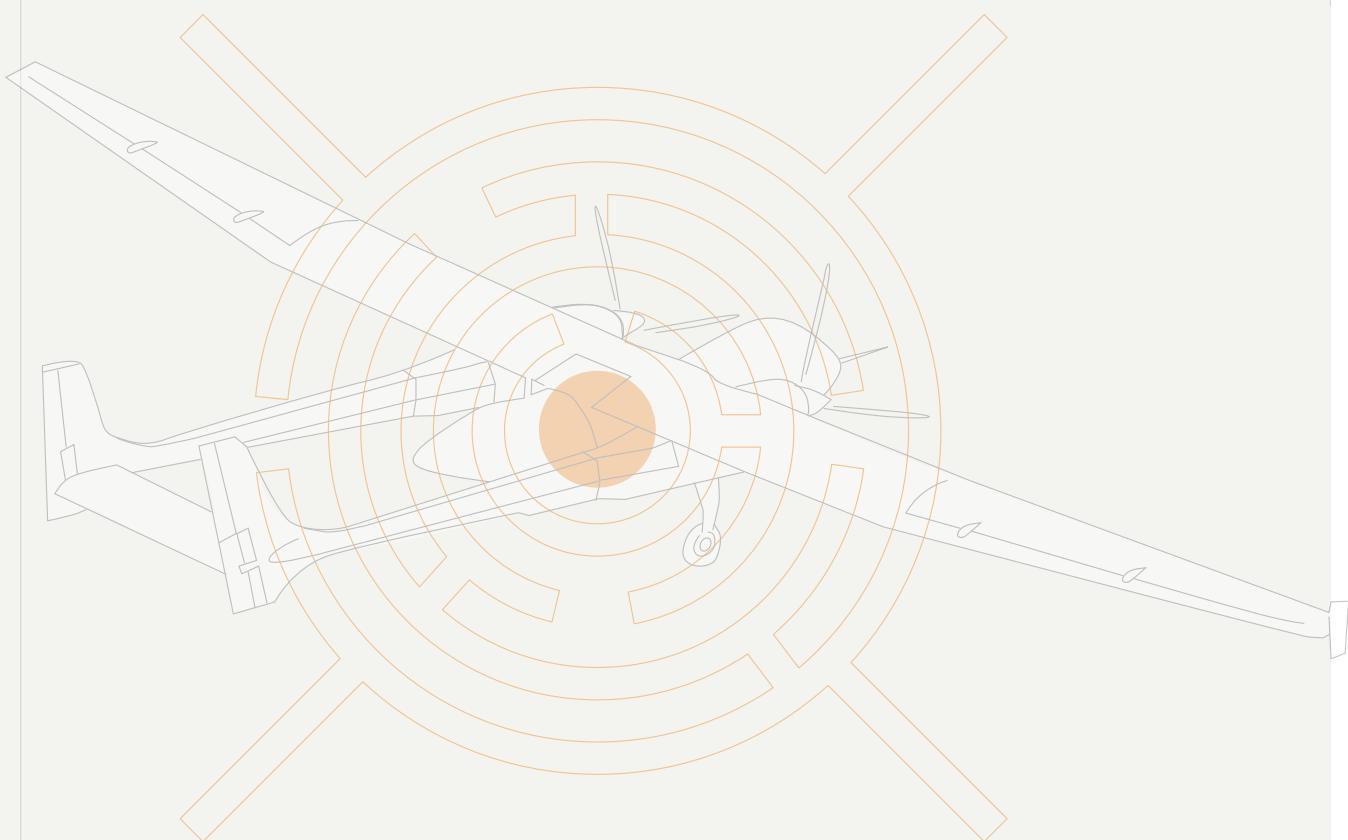
113 The Azerbaijani indirect fires overwhelmed the Armenian defensive line at the outset of the conflict, see: Azerbaijan Ministry of Defense, <https://mod.gov.az/az/news/artilleriya-bolmeleri-dusmene-sarsidici-zerbeler-endirir-video-32411.html>, Accessed on: October 5, 2020;

<https://mod.gov.az/az/news/azerbaycan-ordusunun-bolmeleri-dusmen-movqelerine-artilleriya-zerbeleri-endirir-video-32434.html>, Accessed on: October 5, 2020.

Azerbaijan Ministry of Defense, <https://twitter.com/wwwmodgovaz/status/131312253440194151>, Accessed on: October 5, 2020;

<https://twitter.com/wwwmodgovaz/status/1313126903373586433>, Accessed on: October 5, 2020.

Azerbaijan Ministry of Defense, <https://mod.gov.az/az/news/azerbaycan-ordusunun-bolmeleri-dusmen-movqelerine-artilleriya-zerbeleri-endirir-video-32434.html>, Accessed on: October 5, 2020.



Yet another critical aspect of Azerbaijan's Turkey-supported drone warfare capacity manifested itself in the Armenian armor losses. While the Azerbaijani Armed Forces extensively used drones for executing either direct strikes or ISTAR missions on the Armenian tanks¹¹⁶, the Armenian units' primary weapons of choice against Azerbaijani platforms (tanks and other vehicles) were anti-tank guided missiles (ATGM)¹¹⁷. This very asymmetry between the two belligerent militaries, as well as the sophistication of the Azerbaijani unmanned systems, suggested that "the density of sensors on the modern battlefield is changing the balance in combined arms warfare"¹¹⁸.

The last pillar of Azerbaijan's dronation was information operations. In the footsteps of Turkey's social media activity during the Spring Shield, and other Syria & Libya campaigns, the Azerbaijani Ministry of Defense has systematically released drone footage from the battle-ground, dominating the 'infosphere'.

Overall, starting from Turkey's Spring Shield all the way to Azerbaijan's Second Karabakh War, the Turkish way of drone warfare has risen rapidly. More importantly, resembling the Israeli - Arab wars of the Cold War era, Syrian, Libyan, and Karabakh fronts visibly showcased the superiority of Turkish robotic warfare solutions over the Soviet & Russian-manufactured conventional arms.

¹¹⁶ Azerbaijan Ministry of Defense, <https://twitter.com/wwwmodgovaz/status/1312369474360705025>, Accessed on: October 6, 2020.

¹¹⁷ For the open-source visuals showcasing the Armenian hits, see: <https://www.youtube.com/watch?v=pk7hwI7cH5E>, Accessed on: October 6, 2020.

¹¹⁸ Jack Watling, "The Key to Armenia's Tank Losses: The Sensors, Not the Shooters", RUSI, October 2020, <https://rusi.org/publication/rusi-defence-systems/key-armenia-tank-losses-sensors-not-shooters>, Accessed on: October 7, 2020.

TURKISH DRONE EXPORTS AND TURKEY'S DRONECONOMICS IN CONTEXT

According to a 2020 SIPRI report, Turkey climbed up six spots on average in arms exports¹¹⁹. Turkey's defense and aerospace exports reached approximately \$3 billion in the first 11 months of 2021¹²⁰. This uptrend marks an increase of 40% compared to the previous year¹²¹. The state-owned Tusaş, the manufacturer of the Anka and Aksungur drones, is ranked amongst the Defense News' top 100 defense companies¹²².

Turkey's drone breakthrough was a significant milestone in the nation's geopolitical outlook. Through military contracts and especially drone sales, the Turkish administration builds strategic bonds with other countries, pursuing an effective 'drone diplomacy'¹²³. Alongside establishing a ground for dialogue and cooperation, this strategy also granted Turkey the important leverage of raising its influence over conflicts that it has a stake in¹²⁴. Besides, as the Azerbaijan and Libya cases showed, Turkey's drone exports can play a role in tipping the military balance in armed conflicts.



>>> Figure 10. Bayraktar TB-2 showcased in Ukraine.

119 Lucie Béraud-Sudreau, Diego Lopes da Silva, Alexandra Kuimova and Pieter D. Wezeman, "Emerging Suppliers in the Global Arms Trade", SIPRI Insights on Peace and Security, December 2020, https://www.sipri.org/sites/default/files/2020-12/sipriinsight2013_emerging_suppliers.pdf

120 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#:~:text=This%20figure%20for%202021%20would,within%20the%20next%20five%20years>.

121 Ibid.

122 Defensenews, <https://people.defensenews.com/top-100/>, Accessed on: January 31, 2022.

123 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/>

124 Ibid.

In the past few years, Turkey remarkably boosted its drone exports, entered new markets, and secured its place amongst the world's top drone producers and exporters. Turkey's unique selling point comes with its solutions' combat-proven warfighting capabilities, affordability, and the administration's flexibility in arms sales. These features have allowed Turkish drone sales rise at a rapid rate with a broad exports clientele. Some Turkish drone manufacturers' revenues mainly stem from exports¹²⁵.



Drones make an essential part of Turkey's exports portfolio. Bayraktar TB-2, Anka, and Vestel-Karayel have already earned a place in the international weapons market. Bayraktar TB-2, known as the 'Pantsir-hunter', accounts for most of Ankara's drone exports. According to the manufacturer, Baykar, the UAV has been exported to over 13 different countries,¹²⁶ including Poland, Ukraine, Morocco, Azerbaijan, Turkmenistan, Ethiopia¹²⁷, Kyrgyzstan, Qatar, Niger and Libya¹²⁸. Warsaw is the first NATO nation that decided to procure Turkish drones¹²⁹. Apart from Azerbaijan and Libya, Ukraine loomed large as yet another Turkish client who used Turkey-manufactured drones in combat roles, upon the 2021 Donbass strike.

Morocco inked a deal for 13 Bayraktar TB-2s, with similar plans of purchasing additional units in the coming period¹³⁰. Many other countries such as Latvia, Angola and Pakistan have either expressed their interest in the UAV or have already started the negotiations¹³¹.

Amidst the ongoing war in the country, Turkey's technology cooperation with Ukraine became a hot topic. Turkey and Ukraine had previously worked together in various defense-related issues. Both countries currently cooperate on critical segments of defense industry, such as jet engines, and have penned remarkable partnership agreements such as the Joint Ukrainian - Turkish Commission on Defense Industrial Cooperation. In the last few years, the countries have also started some joint initiatives in drone production. In return for a generous technology transfer and affordable military solutions, Ukraine makes crucial contributions to the Turkish defense industry.

125 <https://twitter.com/Selcuk/status/1485190560222785548>, Accessed on: January 31, 2022,

126 Ayse Betul Bal, "Turkey's Baykar in talks with 10 countries for TB2 UCAV sales", August 4, 2021, Daily Sabah,

<https://www.dailysabah.com/business/defense/turkeys-baykar-in-talks-with-10-countries-for-tb2-uav-sales>

127 Although official sources have not confirmed it yet, open source satellite imagery confirms the presence of Bayraktar TB-2s in Ethiopia.

128 "Turkey expands combat drone sales to Ethiopia, Morocco: sources", Daily Sabah, October 14, 2021,

<https://www.dailysabah.com/business/defense/turkey-expands-combat-drone-sales-to-ethiopia-morocco-sources>

129 Jaroslaw Adamowski, "Poland to buy Turkish Bayraktar TB-2 drones", Defense News, May 24, 2021,

<https://www.defensenews.com/global/europe/2021/05/24/poland-to-buy-turkish-bayraktar-tb2-drones/>

130 Oumaima Latrech, "Morocco to Acquire 6 More Turkish Bayraktar TB-2 Military Drones", Morocco World News, December 2, 2021,

<https://www.moroccoworldnews.com/2021/12/345824/morocco-to-acquire-6-more-turkish-bayraktar-tb2-military-drones>

131 Twitter, November 16, 2021, https://twitter.com/SamBennett/status/1460355264884969479?ref_src=twsrc%5Etfw

Notably, Turkey's latest high-end combat drone Akinci (Raider) is equipped with Ivachenko-Progress engines. Both countries have also taken steps to co-produce the Turkish armed drone Akinci¹³².

The Turkish - Ukrainian strategic partnership also manifests itself in the Black Sea. Recently, the Bayraktar TB's and Akinci's producer Baykar and Ukraine's military-technical conglomerate's member Ukrboronprom signed a joint venture deal – namely the 'Black Sea Shield program'¹³³. The move was significant, as it opened up new avenues for cooperation such as the co-production of aerospace engines and joint production of missile technologies¹³⁴.

In fact, the program already had positive implications, as some Turkish defense companies are currently exploring outsourcing parts of their production or establishing joint production lines with Ukraine. Some leading Turkish defense conglomerates such as Aselsan are expanding their portfolio to cover the Ukrainian market. The company signed lucrative deals with local firms to produce active protection systems and state-of-the-art military communication items in local production facilities set in Kyiv¹³⁵.

Turkey's key projects benefit from this improving relationship. Ukrainian sources claim that the countries are in negotiations for a co-produced, unmanned fighter jet (Kızılelma / MIUS) that would provide an indigenous solution that can complement Turkey's unmanned aerial capabilities. Baykar will run the unmanned aircraft's production that will use Ukrainian-manufactured engines¹³⁶.

By forging new strategic partnerships with its drone exports clientele, Turkey places itself as a rising regional power in Southeastern Europe. In fact, some experts argue that the Turkish foreign policy has been successful in building a new geo-strategic axis by forming alliances with Western-leaning post-Soviet & Warsaw Pact nations, with significant outreach to the GUAM group¹³⁷(Azerbaijan, Ukraine, Georgia, and Moldova). This axis is important in energy-related and security-related agendas vis-à-vis the Russian Federation.

Another Turkish drone that recently attracted foreign clients is Tusaş' Anka UAV. So far, Kazakhstan¹³⁸ and Tunisia¹³⁹, have purchased the Anka drone.

132 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/>, accessed October 2, 2021.

133 Yuri Lapaiev. "The Akinci Strike Drone and Ukrainian-Turkish Defense Cooperation", Jamestown Foundation, February 12, 2020, <https://jamestown.org/program/the-akinci-strike-drone-and-ukrainian-turkish-defense-cooperation/>, accessed October 2, 2021.

134 Yuri Lapaiev. "The Akinci Strike Drone and Ukrainian-Turkish Defense Cooperation", Jamestown Foundation, February 12, 2020, <https://jamestown.org/program/the-akinci-strike-drone-and-ukrainian-turkish-defense-cooperation/>, accessed on 2 October 2021.

135 Göksel Yıldırım, "ASELSAN'dan ihracat rekoru", Anadolu Agency, December 20, 2019, <https://www.aa.com.tr/tr/ekonomi/aselsandan-ihracat-rekoru/1679027>, accessed October 2, 2021.

136 Ukrainian Defense Review, January - March 2020, https://issuu.com/ukrainian_defense_review/docs/udrl_magazine_issuu/s/10208333

137 Taras Kuzio. "Turkey Forges a New Geo-Strategic Axis from Azerbaijan to Ukraine", RUSI, November 18, 2020, <https://rusi.org/explore-our-research/publications/commentary/turkey-forges-new-geo-strategic-axis-azerbaijan-ukraine>

138 "Kazakhstan buys 3 Turkish Aerospace-made Anka UCAsV: Report", Daily Sabah, November 25, 2021,

<https://www.dailysabah.com/business/defense/kazakhstan-buys-3-turkish-aerospace-made-anka-ucav-report>

139 Africa Intelligence, "Tunis takes delivery of its first Turkish armed drones", October 8, 2021,

<https://www.africaintelligence.com/north-africa-business/2021/10/08/tunis-takes-delivery-of-its-first-turkish-armed-drones,109697033-br>, accessed November 21, 2021.



>>> *Figure 11. Vestel Karayel SU Armed UAV in the Papa Air Base in western Hungary¹⁴⁰*

Although the Turkish drone export portfolio is heavily dominated by Bayraktar TB-2, and to some extent the Anka, another Turkish UAV, the Vestel-Karayel (Karayel-SU), is also setting sail to new seas. In November 2021, Karayel-SU, which was already exported to Saudi Arabia, carried out its first foreign testing flight in Hungary¹⁴¹.

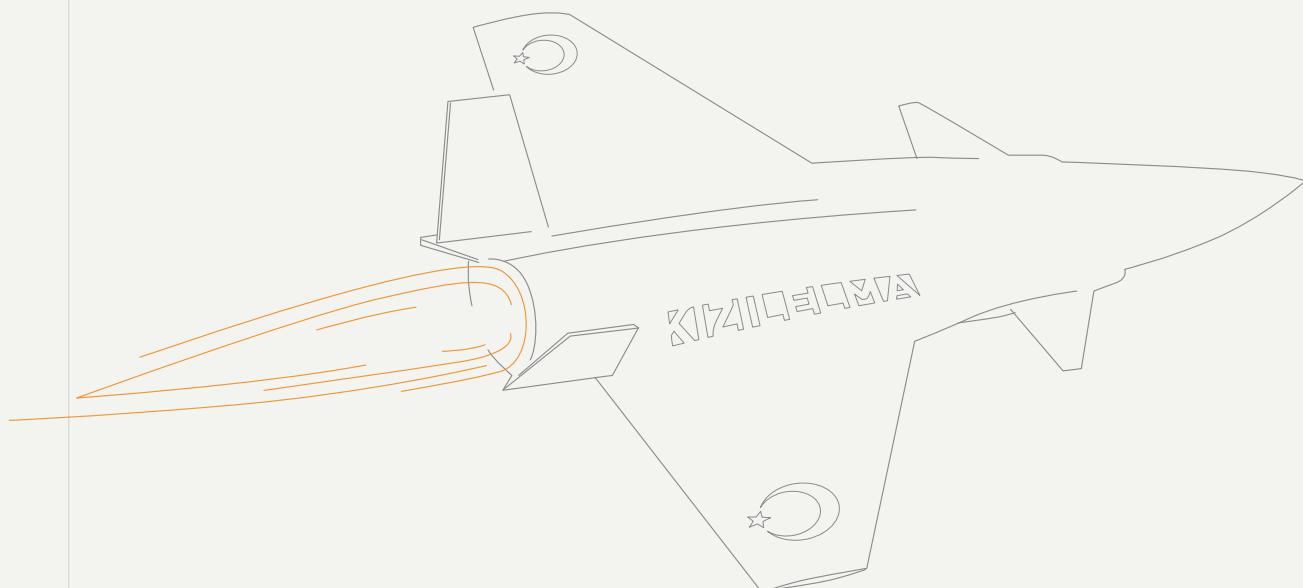


140 Photo retrieved from,
<https://www.raillynews.com/2021/11/vestel-karayel-water-armed-unmanned-aerial-vehicle-in-hungary/vestel-karayel-water-armed-unmanned-aerial-vehicle-in-hungary-2/>
141 Mehmet Yilmaz, "Turkey's armed drones put to test in Hungary: Report", Anadolu Agency, November 13, 2021,
<https://www.aa.com.tr/en/europe/turkey-s-armed-drones-put-to-test-in-hungary-report/2419797>

FUTURE OF TURKEY'S DRONES

In 2021, Turkey introduced two new platforms, hinting at the future of the Turkish robotic warfare posture. The Akinci and Aksungur platforms showcase the design philosophy and operational calculus prioritized by the Turkish defense innovation strategy.

The design philosophy behind Akinci is centered on heavy firepower, a broad array of available munitions, and the utmost objective of providing flexible CONOPS in one platform. The high-end drone will be augmented with advanced sensors, including an AESA radar. Its mission computers are also more sophisticated than Baykar's TB2. Coupled with its ability to fly at 30,000 feet to 40,000 feet altitudes, and its state-of-the-art sensors, Akinci makes a critical intelligence-surveillance-target acquisition-reconnaissance (ISTAR) asset – in addition to the prioritized strike roles – too. (the later variants of Akinci will have 40,000ft plus max. altitude capacity)



Akinci enjoys a large combat payload capacity of 1,5 tons and already flew with Roketsan's smart MAM-T weighing over 90 kilograms during its live-fire tests. The combat payload edge can make a real difference on the battlefield. The principal Bayraktar TB-2 munitions used in the Azerbaijani military's Karabakh campaign, for example, were the smaller MAM-Ls¹⁴², weighing only 22 kilograms. Thereby, the heavier MAM-T will make a true armor-killer almost from all angles of attack. In addition, Akinci can also carry TUBITAK SAGE-modernized joint direct attack munitions (JDAM). In near future, another worthwhile potential configuration for Akinci can be the TRG-230 guided heavy-rocket / tactical ballistic missile¹⁴³, which was exhibited in the IDEF-2021, has a significant circular error probable (CEP) of less than 10 meters, and a warhead with effective combat radius of over 55 meters. If it can be realized, the TRG-230 certification to Akinci can offer an ideal solution against land warfare formations deployed along extensive frontiers or fortified positions.

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ROKETSAN, "MAM-L: Smart Micro Munition", <https://www.roketsan.com.tr/en/products/mam-l-smart-micro-munition>
ROKETSAN, "TRG-230: Guided Missile", <https://www.roketsan.com.tr/en/products/trg-230-guided-missile>



Apart from delivering heavy destructive firepower, Akinci can also participate in deep-strike missions in permissive and semi-permissive airspace. Among the UAS' combat payload configuration, the SOM indigenous air-launched cruise missile line deserves attention. With its effective range around 250 km, the SOM family & Akinci combination would bring about lethal options, such as targeting high-value enemy targets behind the hot zone.

And yet what is true for armed drones tasked with air superiority objectives also applies to Turkey's next-generation solutions, which have little chance against manned aircraft. Although Akinci can be equipped with the indigenous within visual range (WVR) and beyond visual range (BVR) air-to-air missiles (Bozdogan and Gökdogan), there is still no known record of an unmanned aerial vehicle intercepting a manned aircraft. Still, UAS can shoot down other UAS (like when the U.S.' MQ9-Reaper UAV shot down a target drone in military drills in 2018).



>>> Figure 13. Baykar's 'Akinci'.

Overall, while manned aircraft still outweigh¹⁴⁴ drones in kinematic advantages and air-to-air combat, drone-on-drone possibilities currently seem more likely for Akinci. One caveat in this respect could be Akinci (or MIUS Kizilelma, as discussed subsequently), taking part in a manned & unmanned strike package, and firing BVR missiles on a suitable target in a network-centric real-time target acquisition setting. In such a scenario, an unmanned on manned killing would be more likely than dogfights.

In addition to its contemporary warfare roles, Akinci can offer some futuristic warfare prospects. While open-source information on Turkey's future plans is limited, some telltale indicators are worth monitoring.

In May 2019, for example, Turkey's procurement chief Professor Ismail Demir posted an animated footage on his Twitter feed¹⁴⁵, showcasing Alpagu kamikaze drones released by an Akinci UAS. In the video, the Akinci was seen to act as a mothership for swarming strikes delivery. Alpagu and Kargu are equipped¹⁴⁶ with smart algorithms, state-of-the-art image-processing systems, and other sophisticated autonomous features. Thanks to its advanced sensors and the planned AESA radar employment, Akinci can share real-time target acquisition information with the released kamikaze drones. If realized, loitering munitions & Akinci 'mothership' combination can build a major pillar of Turkey's autonomous robotic warfare roadmap.



144 Kyle Mizokami, "A Reaper Drone Shot Down Another Drone in First Unmanned Air-to-Air Kill," Popular Mechanics, September 18, 2018, <https://www.popularmechanics.com/military/aviation/a23320374/reaper-drone-first-unmanned-air-to-air-kill/>

145 Twitter, May 26, 2019, <https://twitter.com/IsmailDemirSSB/status/1132725606418919426>

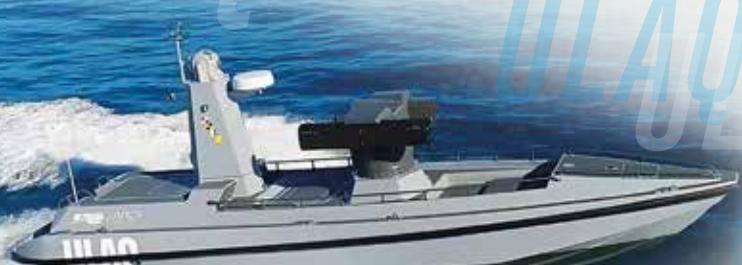
146 STM, "Alpagu: Fixed Wing Loitering Munition System", <https://www.stm.com.tr/en/alpagu>

AKSUNGUR: THE MARITIME PATROL AND ANTI-SUBMARINE WARFARE MASTER

Apart from Akinci, Turkey's next generation drone warfare portfolio has unveiled a promising system, Aksungur. The Turkish Navy has fast become the first receiver of the UAS.

The Aksungur¹⁴⁷ drone of TUSAS - the makers of the Anka line - enjoys a large combat payload capacity of 750-kilograms. More importantly, Aksungur's combat payload configuration includes maritime patrol and anti-submarine warfare systems (sonobuoys and magnetic anomaly detectors), along with signals intelligence (SIGINT) and electronic intelligence (ELINT) options. With 50 hours of endurance, Aksungur enables a sustained loitering time over a large area. Besides, like other modern Turkish solutions in the class, Aksungur has satellite communications (SATCOM) edge, rendering it more resilient in jammed environments. The drone is equipped with advanced sensors, such as the synthetic aperture radar/ground-moving target indicator (SAR/GMTI), augmenting its ability to strike mobile surface targets (i.e. convoys and road-mobile launchers).

Before entering into service, Aksungur performed well in strike scenario tests. In September 2020, for example, the UAS flew 28 hours non-stop carrying a payload of 12 Roketsan-manufactured MAM-L smart munitions¹⁴⁸, and then a 49 hours-long signature flight¹⁴⁹. Just like Akinci, Aksungur will also be able to deliver JDAMs and Roketsan-made munitions with anti-armor capabilities¹⁵⁰.



Apart from the recently received Aksungur, Turkey's powerful Navy also operates the Anka and Bayraktar TB-2 drones. The nation's forthcoming unmanned surface combatant - ULAQ - waiting in line to enter into service¹⁵¹.

With Aksungur, Turkey's anti-submarine warfare and maritime patrol units will operate an additional robotic angle.

From a military planning standpoint, delegating some anti-submarine warfare tasks to unmanned systems will bring certain defense economics gains due to lower operational costs of UAS compared to advanced manned aircraft. Besides, 50-hours non-stop flight endurance is something that piloted aircraft cannot deliver. Given the pronounced Russian submarine activity in the Black Sea and the Mediterranean, Aksungur is likely to contribute to NATO missions as well.

147 TUSAS, "Aksungur", <https://www.tusas.com/urunler/ih/a/yuksek-faydalı-yuk-kapasitesi/aksungur#>

148 Gökse Yıldırım, "Aksungur tam yüklü mühimmatla 1 günden fazla uçtu", Anadolu Agency, September 17, 2020, <https://www.aa.com.tr/tr/bilim-teknoloji/aksungur-tam-yuklu-muhimmatla-1-gunden-fazla-uctu/1976732>

149 Gökse Yıldırım, "Aksungur İHA, 49 saatlik uçuşla imza attı", Anadolu Agency, September 2, 2020, <https://www.aa.com.tr/tr/turkiye/aksungur-ih-49-saatlik-ucusa-imza-atti/1961197>

150 ROKETSAN, "L-UMTAS: Lazer Güdümlü Uzun Menzilli Tanksavar Füze Sistemi", <https://www.roketsan.com.tr/tr/urunler/l-umtas-lazer-gudumlusuzun-menzilli-tanksavar-fuze-sistemi>

151 Dr. Can Kasapoglu, "Analysis - Turkey's robotic warfare efforts set sail to high seas", Anadolu Agency, March 2, 2021, <https://www.aa.com.tr/en/analysis/analysis-turkey-s-robotic-warfare-efforts-set-sail-to-high-seas/2161762>



>>> *Figure 14. Aksungur by TUSAŞ.*

Finally, Aksungur can also make a lucrative export asset. For a long time, Turkey has eyed the Asian weapons market¹⁵², which fits well to unmanned solutions in maritime patrol and anti-submarine warfare tasks.

In summary, Turkey's drone warfare industrial capacity has now shifted from textbook tactical and MALE (medium-altitude / long-endurance) systems to higher-end solutions that can execute strategic missions. This leap will inevitably translate into a boosted warfighting edge, as well as broader, and more lucrative exports clientele. Nevertheless, for any given nation, procuring Turkish drones does not mean an easy path to triumph in the battlefield. In fact, it was the 'Turkish way' of drone warfare that made success possible in hostile fronts such as Karabakh, Syria and Libya.

Overall, Akinci and Aksungur have been important achievements for Turkey, and they represent the future horizons of the Turkish robotic warfare capacity. Turkey's drones, at present, play in a way higher league.

Finally, despite the optimistic tour d'horizon above, one should keep in mind that Turkey's defense modernization uptrend is highly segmented, and the success in drone warfare systems does not inevitably resonate with other areas. In other words, Turkey still needs foreign collaboration in the design and production of certain weaponry. This reality remains evident in complex systems and platforms, such as air-independent propulsion (AIP) submarines, strategic ballistic missile defense weapon systems, fifth-generation aircraft, and space-based assets.

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Sinan Tavsan, "Turkey begins to rival China in military drones", Nikkei Asia, October 7, 2020, <https://asia.nikkei.com/Politics/International-relations/Turkey-begins-to-rival-China-in-military-drones>



KIZILELMA (MIUS) AND BAYRAKTAR TB-3: FORMING TCG ANADOLU AMPHIBIOUS ASSAULT VESSEL'S AIRWING

In 2021, Baykar's technology leader Selcuk Bayraktar announced that the indigenous unmanned aircraft Kizilelma (MIUS) is expected to perform its first test flight in 2023¹⁵³. The upcoming combat UAV, marking Turkey's first turbofan engine drone, will enjoy a 1.5-ton payload capacity, including air-to-air, air-to-ground guided munitions as well as cruise missiles¹⁵⁴. Importantly, thanks to its design philosophy, Kizilelma will have a high rate of maneuverability¹⁵⁵. Able to take off from short-runway platforms, Baykar plans to produce MIUS in compatibility with the Turkish Navy's TCG Anadolu amphibious assault vessel.

Under the variants 'MIUS-A' and 'MIUS-B', the aircraft will be developed with two different engine settings (the latter with an afterburner, and probably trans-sonic setting)¹⁵⁶. MIUS' power pack, in fact, reflects the Turkish – Ukrainian defense cooperation's prospects and future horizons. From a CONOPS standpoint, Kizilelma is probably expected to serve as a 'loyal wingman' within unnamed & manned cooperation framework, and operate alongside 4,5 and 5th generation aircraft.

In the absence of the F-35B, operating TCG Anadolu (based on the Juan Carlos-1 baseline), as a drone carrier is an interesting CONOPS.

¹⁵³ "Baykar's MIUS must be deployed at TCG Anadolu", Tur Def, July 20, 2021, <https://www.turdef.com/Article/baykars-mius-to-be-deployed-at-tcg-anadolu/509>
¹⁵⁴ Ibid.

¹⁵⁵ Cem Devrim Yaylali, "Baykar Makina unveils MIUS UCAV concept", Jane's, July 26, 2021, <https://www.janes.com/defence-news/news-detail/baykar-makina-unveils-mius-uav-concept>
¹⁵⁶ Turan Oguz, "MIUS-A ve MIUS-B iki farklı motorla üretilicek", Sanal Savunma, <https://www.sanalsavunma.com/mius-a-ve-mius-b-iki-farkli-motor-ile-uretilecek/>



>>> *Figure 15. Baykar's Unmanned Fighter Aircraft 'Kizilelma' (formerly known as MIUS)*¹⁵⁷

Baykar's latest drone, TB-3, is specifically designed to be deployed at the TCG Anadolu amphibious assault vessel. In July 2021, Baykar announced that the foldable-winged Bayraktar TB-3 will operate alongside Kizilelma MIUS to support the Blue Homeland geostrategic concept¹⁵⁸. The drone will have a larger payload configuration than Bayraktar TB-2. More importantly, it will be powered by the indigenous PD-170 engine. Its sensor configuration will be based on Aselsan's indigenous solutions¹⁵⁹.



>>> *Figure 16. Bayraktar TB-3 design with folding wings to be embarked on LHDs, Source: Baykar*

157 Photo retrieved from, <https://www.trthaber.com/haber/gundem/yillar-surenen-seruvenin-marka-projesi-mius-596862.html>
Twitter, July 21, 2021,

158 https://twitter.com/BaykarTech/status/1417785316371537924?refrc=twsrct%5Etfw%7Ctwcamp%5Eetweetembed%7Ctwterm%5E1417785316371537924%7Ctwgr%5E%7Ctwcon%5Es1_&ref_url=https%3A%2F%2Fm5dergi.com%2Fsavunma-haberleri%2Fbayraktar-tb3-ile-mius-tcq-anadoluda-birlikte-gorev-yapacak%2F

159 M5, <https://m5dergi.com/savunma-haberleri/tei-bayraktar-tb3-icin-pd170-motoru-teslimatlarina-basladi/>, Accessed on: July 26, 2022.

KEY FINDINGS AND POLICY RECOMMENDATIONS

- The Turkish Armed Forces remain one of the most 'dronized' militaries within the NATO Alliance. This is of particular significance within the Alliance's 2030 perspective. The Turkish administration considers the drone warfare capacity and armed UAS exports to be strategic pillars of Turkey's national capacity.
- Turkish - Ukrainian defense technological cooperation on unmanned systems is a particular matter of concern for the Armed Forces of the Russian Federation. The ongoing war, at the time of writing, has likely worsened Moscow's concerns.
- The Turkish administration does not only sell drones in an off-the-shelf fashion. Instead, Turkey sparks drone warfare eco-systems abroad, and fosters its alliances through robotic warfare transactions. Apart from drone-makers, munitions and sensor makers, such as Roketsan and Aselsan, remain integral parts of these eco-systems.
- Turkey's 'drone diplomacy' has become a tool of political-military influence and smart power leverage overseas.
- Turkish drones have proven to be effective against Soviet-Russian weaponry in various battle-fields. Lessons-learned from these engagements are of critical importance for NATO.
- No matter how sophisticated they are, drones are not silver bullets. Therefore, one must acknowledge that Turkey's UAV breakthrough cannot only be attributed to the industrial know-how but also to the 'Turkish way of drone warfare'.
- While Bayraktar TB-2, and to some extent Anka, have built a name for themselves, the future of the Turkish drone power will be centered on higher-end systems, such as Akinci and Aksungur, and more importantly, Kizilelma (MIUS). Married to Roketsan-made smart weaponry, these systems can play bigger roles in future armed conflicts.
- Turkey has established a credible reputation as a drone power. Nevertheless, it still lacks a roadmap for its drone export policy. The Turkish administration needs to release a white paper covering key issues in this respect.
- While Azerbaijan and the Turkish military targeted Russian clients before, the Ukrainian drone strike in Donbas, and subsequently the Ukrainian Armed Forces' systematic Bayraktar TB-2 use in the ongoing war, marked a whole different story. From now on, it remains to be seen how the Turkish administration will fine-tune the compartmentalized cooperation and competition patterns with Russia.

BAYRAKTAR TB2 >>>

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