

Drone War

How Ukraine Is Rewriting the Grammar of War

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Chapter 1 Spiderweb

The Night \$500 Drones Burned \$7 Billion

1-1 The Trojan Trucks

How 150 Drones and 300 Explosives Were Smuggled into Russia Inside Wooden Containers

Mikhail Ryumin, a truck driver from Chelyabinsk, was 55 years old. His bones were bad. Two spinal discs were damaged, and one arm did not move freely. Even so, he could not give up long-haul freight. Like many long-distance truck drivers in Russia, Ryumin did not have many choices.

In the spring of 2025, Ryumin changed jobs. It was work he had heard about at a truck stop with his colleague Vasily Pitykov. The company, run by a man named Artyom Timofeyev, repaired used trucks and hauled cargo. If only the wages came on time, the two men thought. The first delivery was prefabricated housing parts. Modular building materials packed in wooden containers, the kind truckers called "kabina."

Ryumin headed for the Ivanovo region. Pitykov was stopped by a truck breakdown on a highway in the Amur region, about 600 kilometers from Blagoveshchensk. It was May 31, Pitykov's birthday. When his colleague Viktor called to congratulate him, Pitykov said, "I found a good job. I'm hauling kabina."

What he was hauling was not kabina.

Under the roofs of the wooden containers were hidden FPV quadcopter drones, small four-rotor drones flown from a first-person view. Each cost between \$500 and \$1,000. About the price of a DJI camera drone. Each drone carried two explosives. The roofs of the wooden boxes had been modified so they could be opened remotely.

It was an operation the Security Service of Ukraine (SBU) had prepared for 18 months.

150 drones and 300 explosives. They were divided among five trucks. The trucks moved through Russia's domestic commercial logistics network. They were not passing through border checkpoints. They were ordinary freight shipments inside Russia, driven by Russian drivers on Russian roads. Russian security authorities had no reason to be suspicious.

The trucks were registered to Artyom Timofeyev. A native of Donetsk, he left for Kazakhstan with his Kyiv-born wife, Yekaterina, a few days before the operation. Russian authorities later placed the couple on a wanted list, but by then it was already too late.

The ancient Greeks built a wooden horse and pushed it inside the gates of Troy. What brought down the walls was not a giant weapon, but a small opening that had entered through the gate. Admiral Pierre Vandier, a NATO naval commander, called the operation "a modern reinvention of the Trojan horse."

The comparison was almost exact. Except for one thing. Inside the Trojan horse were volunteer warriors. In these trucks, unsuspecting civilians sat behind the wheel.

1-2 Eighteen Months of Preparation, One Night of Execution

How the Simultaneous Strikes on Five Air Bases Unfolded by the Hour

On the night of May 31, the Russian military unleashed a large-scale air attack on Ukraine. More than 400 drones and missiles flew toward Ukrainian cities. Civilians were killed in Zaporizhzhia, and at one training base 12 Ukrainian soldiers died.

At the same time, inside five trucks parked across Russian territory, nothing was happening. Not yet.

The early hours of June 1.

The signal came.

It was a remote command transmitted through Russia's civilian cellular network. The SBU did not disclose exactly how the communication took place. Some analysts believed Ukraine had built its own communications network inside Russian territory.

Others suggested it had piggybacked on Russia's existing civilian internet infrastructure. Either way, the fact that a simultaneous operation across thousands of kilometers was coordinated remotely is the most astonishing part of the operation.

The roofs of the wooden containers opened. Small propellers began to spin.

There were five targets: Olenya Air Base near Murmansk, Dyagilevo in Ryazan, Ivanovo Severny in Ivanovo, Belaya in Irkutsk, and Ukrainka in the Amur region. The bases stretched across five regions and five time zones.

The column of smoke at Belaya captured in WSJ satellite imagery rose in eastern Siberia, 4,300 kilometers from the Ukrainian front. A video filmed at a gas station north of Irkutsk spread across social media. With smoke already rising in the background, a drone emerged from a wooden box on top of a truck and climbed into the sky. A moment later, another one appeared. Police officers fired pistols in an attempt to shoot them down, but it was useless. The person filming could be heard saying, "Another one flew off! Where are they shooting from? My God, is the technology really this advanced?"

117 drones took off. President Zelensky said each drone had its own pilot. All the pilots were inside Ukrainian territory. Because the drones were FPV drones, the pilots watched the first-person view from the drone cameras and drove them straight into their targets. In footage released by the SBU, a drone could be seen striking the wing of a Tu-95 bomber, right beside the fuel tank. A huge flame rose. It meant the fuel tanks were full. It also meant those bombers had been preparing to launch.

Four of the bases were struck successfully. The fifth truck, headed for the Ukrainka base in Amur, did not reach its destination. It caught fire on the highway. Vasily Orlov, governor of the Amur region, announced that parts of a truck had "caught fire" near the village of Seryshevo. The Ukrainka base was right next to Seryshevo.

The man driving that truck was Vasily Pitykov. The truck driver from Chelyabinsk who had celebrated his birthday the day before.

The SBU agents involved in the operation had all withdrawn from Russia before the attack began. No one was left behind on Russian territory. The entire operation was carried out remotely. President Zelensky said the operation's "office" had been located in one Russian region right next to an FSB office.

It all happened in a single night. But that one night required a year and a half.

1-3 What Was Destroyed

Tu-95MS, Tu-22M3, Tu-160, A-50, and the Crack in Nuclear Deterrence

The figures on the scale of the damage differ by source. Showing that difference honestly is the first step in understanding this operation.

The Security Service of Ukraine announced that 41 aircraft had been hit. It said that amounted to 34% of Russia's strategic cruise missile carrier aircraft. Two U.S. officials told Reuters that about 20 aircraft had been hit, with 10 of them destroyed. Ukraine's National Security and Defense Council (NSDCU) confirmed at least 13 complete destructions. The U.S. military outlet The War Zone visually confirmed, through satellite image analysis, the destruction of 10 to 11 Tu-95MS and Tu-22M3 aircraft. Online OSINT analysts visually confirmed about 14 aircraft shortly after the attack, and that number increased as more imagery appeared.

Russia's Ministry of Defense did not specify how many aircraft were hit. It only acknowledged that aircraft had been damaged and engulfed in flames.

Whichever estimate one follows, the list of what was destroyed chilled military specialists.

The Tupolev Tu-95MS. A strategic bomber that had formed one pillar of Russia's nuclear deterrent since the Cold War. The very aircraft that carried eight Kh-101 cruise missiles and bombed Ukrainian cities. At Olenya Air Base alone, at least four were confirmed destroyed. According to open-source information, as many as 15 Tu-95MS aircraft may have been damaged, roughly a quarter of Russia's entire Tu-95 fleet.

The Tu-22M3. A long-range bomber designed to fly at Mach 2.8 and punch through enemy air defenses. It was an old Soviet design, but it remained a core asset in Russia's long-range strike force.

And the A-50 airborne early warning and control aircraft (AWACS). Russia has fewer than 10 of them. The BBC called the aircraft "the eyes and ears in the sky." One A-50 can guide up to 10 fighter jets at the same time, track multiple targets, and coordinate engagements. One reason Pakistan was able to seize the initiative in the air during the India-Pakistan clash was this type of early warning aircraft. According to Wang Jian's analysis, the operation destroyed at least one of Russia's A-50s, perhaps two. It was not a tactical loss. It was a strategic disaster.

To understand why these bombers matter, one fact has to be known. These are aircraft that cannot be built again.

Russia has not built new Tu-95s for years. The Soviet-era production line is already gone, and Ukrainian officials and Western analysts broadly agree that Russia's current manufacturing capacity cannot reproduce them. According to WSJ analysis, these aircraft were tools of Russian power projection and aircraft meant to carry nuclear missiles.

When one disappears, that is the end of it.

It does not come back.

1-4 The Five Men Who Drove the Trucks Without Knowing Anything

The Gray Zone of War

Mediazona's reporting traced the fate of the five drivers. Published in September 2025, the report revealed the operation's most uncomfortable truth.

All five were long-distance truck drivers from Chelyabinsk. They had faced "various difficulties" at their previous jobs, heard about new work at a truck stop, and started working for Artyom Timofeyev's company. Repairing used trucks and hauling cargo. The pay came, so it seemed good.

Mikhail Ryumin, 55. He was delivering "prefabricated housing parts" to the Ivanovo region. In the early hours of June 1, while dozing inside his truck parked by the roadside, he was awakened by a sudden impact and a loud explosion. He was arrested the next day, June 2. The charge was organized terrorism. The Ivanovo District Court approved his detention. On January 28, 2026, Moscow's Basmanny District Court extended Ryumin's detention. His lawyer argued that detention was unjustified because of his damaged spinal discs and restricted arm movement, but the argument was rejected. From the detention center, Ryumin calls his family and asks how they are. "Are the dogs okay? How is my granddaughter?" He loves dogs. "Please don't give the dogs away. I'll come back." That is what his wife Galina told Mediazona.

Andrei Merkuriyev, 61. He was the driver of the truck caught on video at the gas station near Irkutsk. The video of drones taking off from the top of his truck spread around the world. So did footage of nearby truck drivers and passersby throwing stones to stop the drones. It has not been confirmed whether Merkuriyev himself was among those throwing stones. He was quickly arrested. His ex-wife, Maya Merkuriyeva, told Mediazona that she had received calls "from investigators, from the FSB." But she said she had no intention of helping him. "I don't know what happened, and honestly I don't care." The two had divorced years earlier, and his daughter had not been in contact with him for two years. Through his lawyer, Merkuriyev asked his daughter for forgiveness.

Sergei Kanurin, 47. Also from Chelyabinsk. Like Ryumin, his detention was extended by a Moscow court in January 2026. The charge was organized terrorism.

Vasily Pitykov. The driver of the fifth truck, headed for the Amur region. His truck caught fire on the highway before reaching the Ukrainka base. There were reports that an explosion occurred when someone approached the truck. Pitykov died. It took three weeks for his body to be released to his family. A memorial service was held in Chelyabinsk on June 22, and his remains were cremated and interred on June 27.

Pitykov's colleague Viktor told Mediazona, "The thought that you could be almost 60 and end up in prison for no reason is terrifying."

The name of the fifth driver was not specifically confirmed in Mediazona's report. But multiple sources agree on the fact that one of the five died and four were arrested.

President Zelensky said the drivers did not know drones were hidden inside. In the SBU's operational plan, these people were "part of the means of transport." Civilians who had never chosen war became components in one of the boldest operations of the war.

An uncomfortable question arises here. Militarily, the operation was a success. Strategically, it may have been a sound decision. But what category should we put the use of unsuspecting civilians as carriers of the detonating mechanism into?

Russia defined the operation as a "terrorist attack." Wang Jian pointed out that the comparison did not fit. All the targets hit were military facilities, and no civilian casualties were reported. The Lieber Institute at West Point published an analysis in October 2025 describing the operation as a case of "instrumentalizing civilian objects." It was a paper that directly addressed the gray zone between legality and ethics.

War always has gray zones. The story of these five men shows what that gray zone looks like in its darkest place.

1-5 \$5 Million Versus \$7 Billion

The Arithmetic of Asymmetry

Look at the numbers.

According to Wang Jian's calculation, the pure material cost of 150 drones and 300 bombs was under \$200,000. Each drone cost \$500 to \$1,000. About the price of a DJI camera drone.

Now add intelligence gathering, recruitment of operatives, smuggling of equipment, securing trucks, building communications infrastructure, and 18 months of planning. Even with a generous estimate, Wang Jian calculated that the total did not exceed \$5 million. That figure broadly matched estimates from Western analysts.

Now look at the numbers on the other side.

One strategic bomber costs hundreds of millions of dollars. One A-50 early warning aircraft also costs hundreds of millions of dollars. Ukraine claimed it had inflicted about \$7 billion, roughly 9 trillion won, in damage. That number may be inflated. But even if one follows the most conservative U.S. estimate, that only 10 aircraft were completely destroyed, the losses still run into the billions of dollars.

An input of less than \$5 million. Losses of billions.

Think about where that ratio sits in the history of war. Russia's top-tier assets, which even multimillion-dollar modern air defense missiles had failed to stop, burned because of machines costing a few hundred dollars each. A single Pantsir air defense system costs \$15 million to \$20 million. A \$500 drone pierced the airfield that system was guarding.

The Soufan Center assessed that the operation "shattered the myth of Russia's strategic depth." The assumption that bombers would be safe if they were hidden 1,000 kilometers behind the front collapsed. Where should Russia keep its bombers now? Should it build hardened hangars at every airfield? That was Wang Jian's question. Realistically, does it have the money for that? No. Then expensive aircraft must remain exposed on runways. And when the next surprise attack comes, they disappear again.

The traditional military calculation that a great power can crush a smaller country through a war of attrition. This operation cracked that calculation.

There is a reason the story of David and Goliath has survived for so long. Because it actually happens from time to time.

1-6 "If You Think We're Finished, Think Again"

The Message on the Eve of the Istanbul Peace Talks

The timing of this operation was no accident.

On June 2, Russian and Ukrainian delegations were scheduled to attend peace talks in Istanbul, Turkey. Operation Spiderweb was carried out the day before.

The context matters.

In the spring of 2025, Ukraine was in its most difficult position since the war began. The ground war was deadlocked, and Russia still occupied about 20% of Ukrainian territory. A counterattack near Kursk briefly stepped onto Russian soil, but it did not last. President Trump repeatedly pressed for the war to end, called Putin "my friend," and said he could make a deal. The assumption in Washington, as BBC Kyiv correspondent Paul Adams reported, was that "Ukraine had already lost," and the Trump administration's entire strategy rested on that assumption.

In that situation, what option was left to Ukraine?

To prove, before entering the negotiating room, that it still had the ability to fight.

The operation was carried out only with Ukrainian equipment, with non-U.S. equipment. The United States was not notified in advance. The White House said it had not known about the attack beforehand. A WSJ analyst said, "Ukraine seems to have decided it did not need to inform the United States."

That the operation was achieved with Ukrainian equipment alone was itself the message. It meant Ukraine could strike at Russia's heart even without Western weapons support.

Russia's reaction was fierce. Putin promised retaliation in a June 4 phone call with Trump. Trump warned that Russia's retaliation would "not be pretty." On the night of June 5 to 6, Russia unleashed one of the heaviest air attacks of the war. 452 drones and 45 missiles. Kyiv, Ternopil, Lutsk, Lviv, and other parts of Ukraine were hit. Seven people were killed and 80 were injured. Rescue workers died too. Russia's Ministry of Defense said this was "a response to Operation Spiderweb."

Wars do not end with a single strike. Russia was hit, struck back, and the two sides will keep striking back.

But Operation Spiderweb changed one thing. The balance on the negotiating table.

BBC Kyiv correspondent Paul Adams said in his report that night that it was hard to overstate the daring of the operation. The sinking of the Moskva in 2022, the truck

explosion on the Crimean Bridge that same year, the downing of a Russian fighter jet with a missile mounted on a naval drone just a month earlier, all of them had been extraordinary. But this operation surpassed them all.

The message Ukraine sent to its negotiating delegation on the way to Istanbul, and to the world, was short and clear.

"If you think we're finished, think again."

Donald Trump may have thought Ukraine had no cards left to play. But in the early hours of June 1, as flames rose across five time zones from Siberia to the Arctic Circle, the assumption that there were no cards was scattering with the smoke.

The spiderweb had already been cast.

And that spiderweb was smaller than a bomber, cheaper than a missile, and stretched to places no one had expected.

Chapter 2 Drones Devour War

2022 to 2026

2-1 The Symbol and Limits of Bayraktar

2022, the Opening of Drone War

In March 2022, a song appeared on YouTube.

It was written by the Ukrainian artist Taras Borovok. At the heart of the lyrics was the name of a Turkish drone: "Bayraktar." Each time the chorus came around, the name repeated. The video drew millions of views. One month into the war, there was a pop song. It may have been the first time in history that the name of a weapon became a refrain.

Bayraktar TB2. Made by the Turkish defense company Baykar, the aircraft was a medium-altitude reconnaissance and attack drone with a 12-meter wingspan, 27 hours of endurance, and a price of about \$5 million. In the first weeks of the war, its black-and-white thermal images spread around the world. A camera high in the sky looks down on a Russian tank column. A missile falls. A tank disappears into flame. Then a fuel truck explodes. The long Russian supply column moving toward Kyiv comes to a halt.

The scene showed two things at once.

One was price. Not a fighter jet worth hundreds of millions of dollars, but a far cheaper unmanned aircraft was disabling a huge armored force on the ground. The other was the absence of a pilot. Even if the aircraft was shot down, no person died. The pilot was sitting somewhere hundreds of kilometers away.

There was a reason Bayraktar could show such force. Russia's blitzkrieg plan was poorly made. Under the idea that Kyiv could be taken overnight, Russian armored units drove down the roads in long columns without air-defense cover. They failed to destroy airfields and failed to gain air superiority. In May 2022, The Guardian assessed

that "the TB2 is militarily effective, but it is hard to see it as militarily decisive." The analysis was that Russian failures made the TB2's early success possible.

The cheers did not last long.

As Russia began to recover from the shock, the situation changed. Electronic warfare equipment spread across the front. Once air-defense missile systems such as Pantsir-S1, Buk, and Tor were deployed in an organized way, the TB2's survivability fell sharply. By March 2022, Oryx, a Dutch OSINT analysis group, had visually confirmed 26 TB2 shootdowns. The actual losses were probably much higher.

Serhiy Pashynskyi, a former head of Ukraine's National Security and Defense Council, said this in a call with U.S. officials that was later leaked. "There is more PR and corruption in Bayraktar than real combat use. I was against it from the beginning. It is extremely vulnerable to air defense. They were all shot down within a week."

In October 2023, Colonel Volodymyr Valiukh, an officer of Ukraine's military intelligence service, the GUR, publicly acknowledged the shift at a defense event in Brno, Czechia. "As the war went on, Russian forces strengthened their air defense, and the practical use of the TB2 became limited."

The hero of the war's first stage was gradually pushed into rear-area reconnaissance.

But the TB2's retreat did not mean the failure of drones. It meant the opposite. Large, expensive, slow drones become easy targets in front of modern air-defense networks. Inside that lesson lay the seed of the next revolution. Thousands of cheap drones could be more frightening than a handful of expensive ones. That idea would completely change the shape of the war the following year.

2-2 The Arrival of FPV Drones

2023, the \$300 War Begins

A Ukrainian soldier is wearing goggles and holding a joystick.

What he is piloting is not a military unmanned aircraft. It is a hobby quadcopter of the kind originally used by drone racers. It was assembled from parts bought on the

internet: battery, motors, camera. Attach a grenade or an anti-tank warhead, and it becomes a weapon.

FPV drone. First Person View.

The pilot sees, in real time, what the drone's camera sees. It feels as if he is inside the drone. A Russian trench on the screen grows larger and larger. The movements of soldiers come into view. Then the video suddenly cuts out. That was the moment the drone itself became a bomb.

The price was \$300 to \$500. About 400,000 to 700,000 won.

One Russian tank costs millions of dollars. A single 155-millimeter artillery shell costs about \$3,000, and firing it requires a self-propelled howitzer worth millions of dollars. A U.S.-made Javelin anti-tank missile system costs \$200,000 for the launcher and \$80,000 for one missile. But a 400,000-won drone did the same job. It was an exchange ratio that did not appear in economics textbooks.

By the end of 2023, the landscape of the battlefield had changed.

Village warehouses became arms factories. Drone clubs became military research labs. At his year-end press conference in December 2023, Ukrainian President Volodymyr Zelensky declared, "Next year, we will produce one million FPV drones." By December of that year, Ukraine was already producing more than 50,000 a month.

At first, the drones' operational range was only 8 to 10 kilometers. With signal relays or mother ship technology, it stretched to 40 kilometers. A single soldier hiding in the woods could launch a drone from hundreds of meters away and destroy equipment worth tens of millions of dollars. That age was opening in 2023.

Both sides reached the same conclusion. Ukraine was not the only side using FPV drones. Russia developed and deployed its own FPV drones, including Lightning-1 and Lightning-2, with operational ranges of up to 30 kilometers. Drones were no longer one side's secret weapon. They had become basic equipment for both sides.

The tank was no longer the king of the battlefield.

2-3 The Creation of the Unmanned Systems Forces

2024, the First Drone-Only Branch in History

On February 6, 2024, President Zelensky signed Presidential Decree No. 51/2024.

It was a decree "on increasing defense capabilities." The title sounded ordinary, but inside it was a decision with no precedent in world military history. It created the Unmanned Systems Forces, Syly bezpilotnykh system, abbreviated SBS.

It was not the army. It was not the navy or the air force. It was a separate military branch for drones and unmanned systems alone. The first in the world.

On June 11 of the same year, the SBS officially launched as an independent branch. Its first commander was Colonel Vadym Sukharevskyi. Under it were units that integrated and operated aerial drones, ground unmanned vehicles, and naval drones. By November 2024, more than 170 different unmanned systems had been integrated inside the SBS.

Why did it need to be a separate branch?

Under the old method, drone units were attachments to each brigade. Technology developed here did not move there, and one unit's experience did not make it into another unit's manuals. The commander of the Nemesis regiment explained it this way in an interview with the Kyiv Independent. "Having separate drone battalions within brigades or the military is the right decision. But the Unmanned Systems Forces must exist alongside them. That is what makes it possible to accumulate all experience, all research and development results, and pass them on to the entire armed forces."

It was not a question of volume but of quality. The evolution and application of unmanned systems happened much faster in a separate branch.

At the same time, the industrial ecosystem making drones expanded explosively. When the war began in 2022, Ukraine had 41 drone manufacturers. In 2023, that number rose to 132. In 2024, it became 183. Oleksandr Kamyshin, a former head of the state railway, was called in by Zelensky and became the architect of the national drone program. He

led an industrial shift that lifted annual production from 2,000 units to millions.

It looked like a mixture of Silicon Valley startup culture and a traditional military organization. The measure of competition changed, too. It was no longer a contest over which side could produce more shells, but which side could update software faster.

In a 60 Minutes interview, one drone official said, "The innovation cycle is roughly one week. From the moment you send a drone to the front, to receiving feedback, changing something, and getting a new version, it can be as short as one week."

Asked whether Russia was innovating as well, he admitted it. "Yes, clearly."

2-4 Operation Spiderweb and Fiber-Optic Drones

2025, the Russian Homeland Is No Longer Safe

In early 2025, a new kind of drone appeared on the front.

At a glance, it looked no different from an ordinary FPV drone. The difference was at the tail. A fiber-optic cable, only a little thicker than a strand of hair, unspooled for kilometers, connecting the drone to its pilot. Existing drones communicate by radio. Radio signals can be intercepted. They can be jammed. The reason electronic warfare equipment worth hundreds of millions of won exists is to cut the enemy drone's radio link.

The light inside the fiber could not be cut.

It could not be jammed, it could not be located, and its signal quality did not fall. Ukrainian soldier Serhii Beskrestnov told RFE/RL that even while maneuvering at 60 kilometers per hour, the fiber did not break within a 10-kilometer range. Ptakhy Madiara, Madiar's Birds, later the 414th Unmanned Strike Systems Brigade, even succeeded in testing an FPV drone with a 41-kilometer fiber-optic cable. In January 2025, Ukrainian Commander-in-Chief Oleksandr Syrskyi announced that Ukraine had begun deploying fiber-optic drones in response to Russia's first use of them.

In June of the same year, the world witnessed Operation Spiderweb.

In the early hours of June 1, 2025, explosions occurred almost simultaneously at five air bases across Russia: Olenya near Murmansk, Dyagilevo in Ryazan, Ivanovo Severny in Ivanovo, Belaya in Irkutsk, and Ukrainka in Amur. These were places thousands of kilometers from the front. An FPV drone's operational range is only 15 to 20 kilometers. How was this possible?

The answer had been prepared by Ukraine's Security Service, the SBU, over 18 months. It placed 150 drones and 300 explosive devices inside wooden containers, loaded the containers onto trucks, and moved them through Russia's civilian logistics network to areas near each base. The roofs of ordinary shipping containers were rebuilt with a double structure, and drones were placed in the hidden space between the layers. From the outside, they looked like normal cargo. The Russian drivers did not know what they were carrying. They had only been instructed to set down the containers at the destination.

On the night of May 31, Ukraine sent the signal. The container covers opened, and drones rose into the sky. Russian strategic bombers were exposed on the runways. No one had expected an air raid from so far away. There had been no budget to build hangars, either. The drones, trained with AI, recognized 3D models of Tu-95, Tu-22M3, Tu-160 bombers and A-50 early warning aircraft, then attacked their most vulnerable parts: engines, fuel tanks, and missile mounting points.

Ukraine claimed 41 aircraft destroyed. NATO estimated 10 to 13 were completely destroyed. Two U.S. officials told Reuters that about 20 were hit and 10 destroyed.

Whichever number is closer to the truth, the strategic shock was clear. Russia effectively had no capacity to build new Tu-95s. They were Soviet aircraft from the Cold War, and once they disappeared, they would not return. Russia had fewer than 10 A-50 early warning aircraft in total, and one such aircraft could guide and coordinate 10 fighter jets at the same time.

The estimated cost of the operation was under \$5 million. The estimated damage was \$7 billion. It became a textbook example of asymmetric war.

The war crossed another threshold. The concept of the rear began to shake.

2-5 100 to 200 Sorties a Day, 1,000 Interceptor Drones Produced Daily

2026, the Drone-Saturated Battlefield

In a 2026 interview with the Kyiv Independent, the commander of the Nemesis regiment described the current battlefield this way.

"Across every part of the battlefield where fighting is happening on both sides, the saturation of drone crews and drones themselves is already so high that any infantryman can become the target of a precision strike within minutes."

The front line of 2026 was nothing like 2022.

Before the sound of artillery, there was the sound of drones. Soldiers looked up at the sky first. The battlefield reality reported by the 60 Minutes team was this: "Every vehicle within five kilometers of the front, whether a tank, armored vehicle, or ordinary truck, is effectively facing death, because drones are constantly scanning and constantly hunting."

As attack drones increased, defensive drones appeared as well. Sting drones emerged to intercept Russia's Shahed suicide drones and cruise missiles in midair. It was an era in which another drone was launched to catch a drone. In early 2026, President Zelensky said Ukraine had "the capacity to produce 2,000 interceptor drones a day." As of February 2026, these interceptor drones were responsible for 70% of Shahed interceptions in the Kyiv region.

The scale of the numbers had reached a level beyond imagination.

As of 2026, Ukraine's annual FPV drone production capacity had surpassed 8 million units. This was an official announcement by Ukraine's National Security and Defense Council, the RNBO. More than 160 manufacturers, large and small, were producing FPV drones. Russia tried not to fall behind. In May 2026, Commander-in-Chief Syrskyi warned on Telegram, "Russia plans to produce 7.3 million FPV drones and 7.8 million warheads in 2026."

Together, the two sides were making tens of thousands of drones a day, launching thousands, and losing hundreds on a single battlefield. Military analysts called this "drone saturation."

In this saturation, the shape of the front changed.

Borrowing the words of a drone commander, "The line of contact or combat separation line, the so-called gray zone, is expanding. This gray zone is now completely controlled by drones. And on both sides, there is infantry." Franz-Stefan Gady, a Vienna-based military analyst, gave this assessment to The Irish Times. "By deploying swarms of FPV drones, Ukraine has built a 20-kilometer-deep kill zone and restored drone-war parity or superiority in certain sectors of the front. Ukraine can be seen as being in a better military position in May 2026 than in May 2025."

The innovation cycle of technology had narrowed to one week. Feedback from the front was immediately reflected in production and improvement. Yesterday's countermeasure was already neutralized today, and by tomorrow a new version appeared.

2-6 Eighty Percent of Casualties Come from Drones

What It Means That Production Jumped from 2,000 a Year to Millions

Let us put down the numbers first.

In 2022, when the war began, Ukraine's drone production was at the level of several thousand units a year. In 2024, it procured more than 1.5 million FPV drones alone, and total drone production passed 2 million. In 2025, total production reached about 4.5 million. Monthly FPV drone production capacity jumped from 20,000 a month in 2024 to 200,000 a month in 2025.

As of 2026, Ukraine's annual FPV drone production capacity is 8 million. Russia's planned production is 7.3 million. Combined, the two sides are making more than 15 million FPV drones a year for a single battlefield.

Behind these numbers, which look like industrial statistics, lies a change in the character of war.

In an official statement in January 2026, Ukraine's National Security and Defense Council, the RNBO, said, "FPV drones are our asymmetric response. Today, 60% of Russian military losses are caused by FPV drones." According to reporting by the Kyiv Post, statistics from some units showed that drones caused between half and two-thirds of Russian personnel losses and destroyed combat vehicles. In his 2024 annual review, Commander-in-Chief Syrskyi said that, across all weapons systems, drones caused almost half of Russian casualties.

In May 2026, Syrskyi released data that went one step further. "Since December, Ukrainian drone units have been eliminating more Russian troops every month than Russia can mobilize." Drones came to handle more than 60% of battlefield logistics as well as combat missions. Evacuating the wounded, supplying ammunition, even laying mines.

The domestic production share of Ukrainian military drones exceeded 95%. Defense Minister Rustem Umerov gave a figure of 96.2% for 2024. The main reason for the shift to domestic production was that foreign suppliers could not match the speed of feedback from the front. In the process, Ukraine moved from being a consumer to being an exporter. From 2025, it began selling naval drones, electronic warfare systems, and interceptor technology overseas, and opened arms export offices in 10 European countries.

According to GIS Reports, in April 2026, German Chancellor Friedrich Merz and President Zelensky were seen together at the Chancellery in Berlin examining drones made through German-Ukrainian drone cooperation. Across Europe, drone and counter-drone startups were being founded at high speed, and many received EU subsidies. Ukraine's battlefield experience was the foundation of this ecosystem.

Twentieth-century war was the age of cannons, tanks, and fighter jets.

Twenty-first-century war is moving toward a contest of sensors and software, batteries and algorithms. For a long time, the history of war was the history of gunpowder and

steel. The Ukraine war is changing the direction of that history. Huge warships, bombers, and tanks are not disappearing. But they now have to share the same space with a new predator.

Cheap, small, countless machines.

In 2022, people called drones a new weapon.

By 2026, drones were no longer one weapon among many. They had become the environment that made up war itself.

Chapter 3 The Front-Line Kill Zone — Land Where Neither Men Nor Tanks Survive

3-1 The 10-Mile-Wide Kill Zone — The Reality of a Battlefield Ruled by FPV Drones

At four in the morning, the supply road behind the Donetsk front is empty. Not because the road has been cut. Because the moment you step onto it, survival becomes difficult.

In the past, a soldier heard the sound of artillery and ducked. Today's soldier dies without hearing anything. If the faint whine of a small motor can be heard, it is often already too late. Somewhere in the sky, a reconnaissance drone is hovering, and several kilometers behind it, an FPV drone operator is watching a screen. One soldier, one stretcher, one pickup truck, one tank, all are targets on that screen.

The description of the Ukrainian front given by the 60 Minutes team was this: "Forget everything you know about war." The traditional front line, the no-man's-land that once meant the narrow empty space between two lines of trenches, has now expanded into a vast kill zone about 10 miles, or 16 kilometers, wide. Anyone who steps into it can be spotted and hunted by a drone operator.

That number has been widening in 2026. In a May 2026 interview with *Ukrainska Pravda*, Magyar, Robert Brovdi, commander of Ukraine's Unmanned Systems Forces, said the depth of the kill zone now reaches more than 25 kilometers on both sides of the front. Not 25 kilometers on one side, but 25 kilometers on both sides. Taken together, it is a 50-kilometer-wide belt stretching along a 1,200-kilometer front. Magyar added: "I do not recommend anyone to approach within 25 kilometers of this gray front-line zone without proper preparation, necessity, and protective equipment."

Ten miles, or 25 kilometers, looks small on a map. But at the front, that distance is the corridor between life and death. The road that must carry ammunition, the road that must bring out the wounded, the road through which replacement troops must enter, the road a tank must take to advance, all of it lies inside that zone. If the old

no-man's-land was a narrow gap of a few dozen meters between trenches, today's no-man's-land is an invisible fence pushed deep into the rear of the front. It cannot be seen, but everyone knows it is there. If you move inside it, you are filmed. Once filmed, you are tracked. Once tracked, you are hit.

The situation on the eastern front reported by AP was brutal. As FPV drones watch and strike deep behind the front, evacuating the wounded has become visibly harder. Medics in the field said they had hardly seen gunshot patients for months, and that most injuries now come from drones. There was a time when bullets were the language of war. Now the grammar of the front is written with propellers, cameras, and batteries.

The words of the Nemesis regiment commander compress the nature of this battlefield into a single sentence. "In every area of the battlefield where fighting takes place, on our side and on the enemy side, the saturation of drone crews and drones themselves is already so high that any infantryman can become the target of a precision strike within minutes." Infantry, tanks, and artillery have now become supporting actors. Drones enter the battle first, and every other unit serves to support them.

This change binds attack and defense at the same time. Russian forces cannot push through a large armored breakthrough, and Ukrainian forces cannot maintain rapid maneuver across a broad front for long. The front still moves, but that movement is not the old blitzkrieg. It is like pushing cloth upward with the tip of a needle. A tank worth millions of dollars fears a drone worth a few hundred. A soldier in a trench is not safe either. Windows, doorways, vehicle interiors, forest roads, gaps between buildings, all are caught by cameras.

In a March 2026 report, Telegraph journalist Verity Bowman described the new shape of the battlefield this way. As Ukrainian drones became able to strike up to 150 kilometers behind the front, the kill zone, which had previously been limited to within 50 kilometers, had tripled in size. Behind that expansion was Ukraine's systematic work to destroy Russian air-defense systems and electronic-warfare equipment, and at the center of it was the Deep Strike Command Centre, created in early 2026 by the

Unmanned Systems Forces.

The strategic goal is cold and clear. Kateryna Stepanenko, a researcher at the Institute for the Study of War, said in the same report: "The goal is to make Russian troops walk to the front. If vehicles cannot move safely, soldiers must cover that distance on foot. They arrive exhausted and carry less."

A drone is the eye that looks down on the battlefield and, at the same time, the blade that leaps from that eye. Once the eye and the blade became one body, the air over the front changed.

3-2 Frankenstein Tanks and Nets — Improvising to Survive, and the Limits of It

Steel bars went up over tanks. Wire mesh was laid over armored vehicles. Some vehicles had roofs and sides covered with metal plates, making them look like sheds. Soldiers called them "turtle tanks" and "barn tanks." When a war drags on, weapons are not born only in factories. They are also born in field repair shops, abandoned warehouses, and beside welding sparks.

In 2024, Ukrainian forces captured a Russian T-62 tank modified to counter the drone threat. According to Reuters, the tank had a box-shaped metal shell, rear bars, and electronic-warfare equipment plastered onto it. It was reportedly used for supply and troop transport. But Ukrainian soldiers judged the modification to have been hastily made and limited in effect. Adding more metal may look as if it will help you survive, but FPV drones always search for gaps. They dive underneath, circle behind, and aim at places where the wire mesh is broken.

A tank tangled with scrap metal, wire mesh, and electronic-warfare equipment looks less like a regular army weapon than an animal stitched back together after a storm. 60 Minutes called vehicles of this kind "Frankenstein tanks." It meant battlefield inventions improvised with cages and nets to fend off drone attacks. Their appearance is absurd. But inside that absurdity sit both the fear and the wisdom of soldiers.

Nets have become the new roof of the front.

Wooden or metal poles are set up over roads, and nets are stretched across them. From a distance, it looks less like a battlefield than a passage through a vineyard. But the vehicles passing beneath them carry ammunition, food, wounded soldiers, and exhausted troops. In February 2026, Ukrainian Defense Minister Mykhailo Fedorov said Ukraine planned to install 4,000 kilometers of anti-drone nets over front-line roads by the end of the year. In January 2026, installation proceeded at 5 kilometers a day. In February, it rose to 12 kilometers, and from March the target was set at 20 kilometers a day.

As of early June 2026, Ukraine had laid 822 kilometers of anti-drone defensive netting over front-line supply routes. According to Euromaidan Press, 211 kilometers were newly installed in May alone, and 38 kilometers of damaged sections were repaired. There were also reports that retired fishing nets from France and Sweden were being sent to Ukraine and reused as anti-drone barriers.

Nets entangle drone propellers. If an incoming aircraft is caught, it explodes before reaching its target, or simply falls. If electronic-warfare equipment cuts off a drone's signal, a net physically grabs the drone's body. But nets are not a complete shield either. Repeated attacks tear them. As fiber-optic drones, which ignore radio jamming, become more common, the usefulness of electronic-warfare equipment also falls.

The scene reported by UNITED24 Media from Izium in Kharkiv Oblast in April 2026 is striking. Nets had been spread over main roads, alleys, and even supermarkets in the city, 30 kilometers from the front. This was the same city where 449 bodies were found in a mass burial site during the Russian occupation in 2022. Residents said the nets overhead were both a shield and a warning that Russia was coming close again.

So front-line defense is built in layers. Electronic warfare, nets, camouflage, rapid movement, nighttime evacuation, even ground robots. When one shield is added, one spear changes. A single wire mesh frame on a Frankenstein tank can buy one minute. On a battlefield, one minute can be as large as a human life.

3-3 Drones That Do Not Fly — Ground Unmanned Vehicles with Machine Guns, and the Robot That Held Off Russian Attacks Alone for 45 Days

When people hear the word drone, they first look up at the sky. But now drones are also moving across the soil of the front.

Things with wheels, things with tracks, things with low bodies carrying ammunition, things mounted with machine guns, things pulling stretchers, things charging forward with explosives, all crawl along the lower layer of the front. If aerial drones rule the space above a soldier's head, unmanned ground vehicles, UGVs, tread the ground where soldiers would otherwise have to walk.

In late 2025, one scene showed the future of war. A Ukrainian Third Corps ground unmanned vehicle, the Droid TW 12.7, fitted with a 12.7-millimeter M2 Browning machine gun, guarded an intersection on the eastern front alone for 45 days. It received battery replacement, ammunition resupply, and maintenance once every two days, but no human stayed in that position. Mykola Zinkevych of the Third Corps said: "Only the UGV system was in that position. That is the core concept. Robots do not bleed."

This scene brings back an old question of war. Who must stand in the dangerous place. The old answer was the soldier. The state called, the unit ordered, and the soldier entered the trench. Today's answer is changing little by little. Send the robot first. The robot opens the road, carries ammunition, watches, and fires. The human steps back.

The numbers show that direction. According to data from the Ukrainian Defense Ministry's DELTA battlefield management system, the number of ground unmanned vehicle missions jumped from 2,900 in November 2025 to 7,500 in January 2026, and exceeded 9,000 in March. In the first quarter of 2026 alone, about 24,500 combat and logistics missions were carried out by ground robots. In March, 167 units were operating this equipment, compared with 67 units in November 2025. Foreign Policy reported in April 2026 that at least 12 brigades in the Ukrainian military were recruiting dedicated robot operators.

In footage filmed by Radio Free Europe/Radio Liberty on the Pokrovsk front in eastern Ukraine, one commander pointed to a ground unmanned vehicle and said: "This is our combat ground drone. It went out yesterday evening and returned this morning. It is

equipped with a machine gun and hundreds of rounds of ammunition." In realoperations, this machine killed enemy soldiers and took on the most dangerousmissions in hazardous areas like Pokrovsk, where Russian forces were trying to encircleUkrainian positions.

In January 2026, it was reported that three Russian soldiers surrendered to a Ukrainian ground unmanned vehicle near Lyman. It is believed to be the first recorded case in the history of warfare in which humans surrendered to a remotely controlled ground vehicle. That same month, the Third Assault Brigade released video of a suicide ground unmanned vehicle carrying 12 TM-62 anti-tank mines and attacking a building where Russian troops were hiding.

Brigadier General Andrii Biletskyi, commander of the Third Corps, argued that units that actively integrate ground unmanned vehicles could reduce their need for front-line infantry by up to 30% by the end of 2026, and perhaps by as much as 80% in the future. In an April 2026 speech on Weapons Manufacturers Day, Ukrainian President Zelenskyy described an operation in Kharkiv Oblast the previous summer in which NC13, the robotic strike unit of the Third Assault Brigade, captured Russian positions using only aerial drones and ground unmanned vehicles. According to CNN, Russian soldiers eventually raised a piece of cardboard saying "we want to surrender" and were guided by drones into captivity.

But robots are not battlefield magicians. Batteries drain. Tracks come off. They get stuck in mud. Radio links cut out. When ammunition runs out, someone has to go near them and reload. The commander at Pokrovsk said: "Sometimes they arrive and are quickly destroyed, and sometimes they operate for hundreds of kilometers." Then he added: "But losing a machine is better than losing a person." Between a ground unmanned vehicle with an average price under \$20,000, armored vehicles worth tens of millions of dollars, and a soldier's life, which has no price, the calculation is changing.

Just because humans have stepped back does not make war less brutal. Only the place where blood is spilled changes.

3-4 Machines That Retrieve Bodies and Evacuate the Wounded — Armored Drones Built by a Brewery Engineer

Evacuating the wounded looks like the work that comes after battle. At the front, evacuation is battle. Sometimes the moment a stretcher is lifted is more dangerous than the moment a gun is fired.

A wounded soldier cannot move. A soldier carrying a stretcher cannot hide quickly. An ambulance is large and easy to see. And drones like moving things. The reality on the eastern front reported by AP was this. As FPV drones strike deep behind the front, casualty stabilization points must move more often, evacuation vehicles must take longer detours, and medics must protect both the patient and themselves. A structure has emerged in which delays in evacuation, more than the injury itself, lower the chance of survival.

So machines have begun to carry stretchers instead.

Roman Tkachynskyi is a former brewery engineer. A man who once made beer now makes armored drones that save wounded soldiers. Tech Core, the private technology company he founded, has developed an armored evacuation drone that can remotely move wounded soldiers safely under fire at the front. Demonstrating the drones at a military training ground for the 60 Minutes team, he said they had saved hundreds of lives.

When the reporter asked, "How do you figure out what the next design needs?" Tkachynskyi answered: "We work with the end user. The end user means the soldiers at the front." The soldiers said they needed evacuation drones, and he made them. "That is how it works in Ukraine. We design for the soldiers."

The reason this scene is symbolic is clear. New equipment for war no longer comes only from the meeting rooms of major defense companies. Brewery engineers, technicians who repaired farm machines, young people who handled 3D printers, and soldiers familiar with gaming controllers all move as one mass.

In November 2025, there were reports that ground robots carried out wounded evacuation missions despite mine explosions and drone attacks. In December, another case was reported in which a ground robot carrying a wounded soldier was attacked by Russian drones, but its armored capsule protected the soldier from further injury. In 2026, Ukrainska Pravda reported a case in which ground robots of the Third Corps evacuated four civilians, including a wounded woman, from the gray zone on the Lyman front.

Body retrieval is the same. Bringing back a dead soldier is a military ethic and a final duty to the family. But on a front where drones are hovering, living soldiers die while trying to recover bodies. On the front covered by Radio Free Europe, one operator pointed to a ground drone capable of retrieving bodies and said: "It arrives by itself, loads by itself, and leaves by itself."

War always speaks of human dignity. To preserve that dignity, metal tracks now step into the mud. It is a cold scene. Still, inside that coldness, something human remains.

3-5 Drones That Hunt Drone Hunters — The Logic of Mutual Destruction

At the front, drones are hunters. But hunters soon become prey.

When a reconnaissance drone rises, the other side looks for the direction of its signal. When an FPV drone operator turns on a transmitter, electronic-intelligence equipment follows the trace. Anti-drone guns, electronic-warfare equipment, interceptor drones, buckshot, machine guns, nets, and decoys follow. Then drones fly out to destroy that electronic-warfare equipment. The equipment that catches drones becomes a target, and new drones appear to catch the drones that attack that target.

The mission of the Nemesis regiment shows this well. In an interview with the Kyiv Independent, the regiment commander explained: "Our task is to destroy the enemy's order of battle. We remove all artillery and howitzers so they cannot fire, and we locate and destroy enemy drone operator crews. We destroy enemy air defense to improve the work of our aerial reconnaissance." It is the harsh logic that only by first cutting off the enemy's eyes and hands can the death rate of friendly infantry and equipment be

lowered.

In 2026, this logic is crossing a new threshold. Ukraine's Defense Ministry announced that next-generation interceptor drones autonomously track and shoot down Russian Shahed-type attack drones. The war is moving from the stage in which a human pilots a drone to the end, to the stage in which a drone recognizes, tracks, and collides with another drone. The sight of small machines finding and striking one another in the sky may look like a toy war. But beneath it are city power grids, supply routes, hospitals, and trenches.

This mutual war of destruction moves by the logic of cost. If expensive missiles are used to shoot down cheap drones, it is hard to endure for long. So cheaper means of interception are needed. Reuters' report that Northrop Grumman is testing longer-range anti-drone rounds based on feedback from Ukrainian forces belongs in the same context. The attempt to catch drones with medium-caliber autocannons and proximity-fuzed rounds instead of missiles shows that this war is increasingly becoming a fight over "the price of one shot."

The problem is not victory, but attrition. When one side makes a new drone, the other side makes new jamming equipment. When electronic warfare grows stronger, fiber-optic drones appear. When fiber-optic drones spread, nets grow longer. When nets are laid, drones search for a different angle. When a cage is placed over a vehicle, a drone searches for a gap. When the gap is blocked, a larger warhead is attached. The front is a mirror room. Attack and defense grow by copying each other's faces. This war is not an exhibition of inventions. It is a laboratory built by the fear of staying alive.

3-6 The One-Week Innovation Cycle — From Front-Line Feedback to a New Version, and Soldiers Under Constant Surveillance

The technological innovation of the Ukraine war does not follow a leisurely research-and-development timetable. A problem appears at the front. A drone falls because of jamming. A camera is weak at night. A battery cannot withstand the cold. Russian forces put up new nets. The operator sends footage through Telegram and dedicated channels, the engineer changes parts, and a small factory makes a new

version. A few days later, it goes back to the front.

A reporter asked Tkachynskyi of Tech Core, "How fast does the technology change?" His answer was this: "The innovation cycle is about one week. From the moment we send a drone to the front, receive feedback, change something, and get a new version, it can be as short as one week." In the past, changing one generation of tanks took years. Now a drone's antenna, frequency, camera, warhead, and software change week by week through front-line feedback.

Asked whether Russia also innovates, Tkachynskyi was frank. "Yes, definitely. We have to admit that." Asked who has the advantage, he answered: "For now, I would say it is a balance. A balance in the drone arms race."

There are numbers behind this speed. According to Reuters, Ukraine planned to purchase about 4.5 million domestically produced FPV drones in 2025, and had secured more than 1.5 million in 2024, 96% of them domestically produced. Oleksandr Kamyshin, an architect of the drone program, described in a 60 Minutes interview how Ukraine raised drone production from 2,000 units a year to 4 million. According to a 2026 CEPA report, Ukraine's National Security and Defense Council said the Ukrainian defense industry has the capacity to produce more than 8 million FPV drones a year.

The Ukrainian defense-technology ecosystem called Brave1 is an attempt to institutionalize this flow. If prewar startups searched for investors and customers, wartime defense startups take trenches and operators as their customers. Product evaluation is cold. Does it survive at the front. Does it find the enemy. Does it withstand interference. Can it be made again.

Ukrainian Defense Minister Fedorov said that since January 2026, through the digital procurement system, more than 181,000 drones, ground unmanned vehicles, and electronic-warfare systems had been supplied to the front at a cost of more than 14 trillion hryvnias, about \$330 million. It is a system that allows front-line units to order equipment directly from domestic manufacturers.

For soldiers, this speed is both salvation and punishment. When new equipment arrives, the chance of survival rises. Better cameras, more stable links, and faster

interceptor drones save soldiers. But the other side changes at the same speed. A road that worked today becomes a road of death tomorrow. Cover that was safe yesterday becomes a target with coordinates today.

It is not enough to say that drones surveil the battlefield. Drones surveil a soldier's time. They record when he moved, where he stopped, which trench people gathered in, and which road evacuation vehicles use. A soldier at the front relearns how to hide before he learns how to fight. He even reduces the moments when he smokes. He calculates the time it takes to open a vehicle door. He does not stay in one place for long. He does not move by day, and even night is not completely safe. Thermal cameras search for body heat, and low-light cameras strip away darkness. Fiber-optic drones fly in even through the silence of electronic-warfare equipment.

In a November 2025 report, the BBC said that up to 90% of supplies to Ukrainian front-line positions were already being delivered by unmanned means. Robots now cover distances where a person walking could die.

Humans are becoming smaller and smaller on the battlefield. They must become smaller to survive.

The front line in Chapter 3 is not a road for heroic charges. It is land turned into a vast killing apparatus. People dig trenches, tanks wrap themselves in wire mesh, ambulances lose their way, robots pull stretchers, and drones fly off to find drones. Here, victory and defeat in war are not decided by one great offensive. It is a fight over who sees faster, makes things more cheaply, repairs faster, and endures longer.

The soldier at the front does not look up at the sky. Because the moment he looks up, it may already be too late. Instead, he lowers his ears, lowers his body, lowers his breath. Above him, a small machine passes.

War has not grown larger. It has grown smaller. So small that now death finds one person inside a screen the size of a palm.

[Endnotes]

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Chapter 4 David at Sea — A Country Without a Navy Forces a Fleet to Retreat

4-1 From Cossack Galleys to Sea Baby — The Maritime Drone Development History of Ukraine's Security Service (SBU)

It looks like a fishing boat.

That is what a 60 Minutes reporter said when he first saw it beside a frozen lake. A small boat with an outboard motor. It would not look strange if a fisherman took it out. Yet inside this little boat, 2,000 kilograms of explosives can be loaded. Enough to sink a Russian warship.

The pilot standing beside it had his face blurred. He was on Russia's assassination list. The reporter asked him. Which is more useful, one warship or ten maritime drones like this? The pilot did not hesitate. The maritime drones, he said. These drones are small, so they are really hard to destroy. It is far better to have ten boats like this than one big ship.

Sea Baby. The baby of the sea. This is the name of the unmanned surface vessel made by Ukraine's Security Service, the SBU. The name is exquisite, because what it does is far too rough to be called baby-like.

The SBU is not the military. It is the Security Service, an intelligence agency. Intelligence agencies do not usually develop weapons. But when Russia invaded in February 2022, the Ukrainian navy had effectively already disappeared. It had almost no large surface combatant force. Since Russia occupied Crimea in 2014, there had been little the Ukrainian navy could do in the Black Sea. By contrast, Russia's Black Sea Fleet had cruisers, landing ships, submarines, and missile boats packed into the port of Sevastopol. It was a fortress on the sea.

SBU director Vasyl Maliuk looked for another path. The memory he pulled out was an old one. The Cossack chaika. A small galley that moved across the Black Sea in the sixteenth and seventeenth centuries. Cossack warriors faced the Ottoman Empire's

huge galleons, but instead of fighting big ships head-on, they used low, fast boats to strike their flanks. The phrasing used in the SBU's official video is exact. "It is the evolution from traditional suicide drones reminiscent of Cossack galleys into very high-tech maritime platforms."

The design began in the summer of 2022. The SBU's special operations unit led it, and civilian engineers joined. The first prototypes were made not in shipyards, but in warehouses and on workbenches. From 2023, the name Sea Baby began to be heard in combat, and Ukraine's fundraising platform United24 disclosed the price of one drone as \$221,000. It said the drone could carry 850 kilograms of explosives.

One small boat had become a floating ammunition depot, a reconnaissance platform, and a missile launcher. Behind the birth of this machine lies a question repeated throughout the history of naval warfare. If you do not have big ships, can you still fight at sea? The Cossacks answered yes, and 400 years later, the SBU wrote the same answer again with electronics.

4-2 Ten \$300,000 Drones Versus One Warship Worth Tens of Millions — The Choice Made by a Drone Pilot

The calculation sheet of traditional naval warfare lists displacement, gun caliber, number of missiles, and number of crew. The new calculation sheet Ukraine made contained different numbers. The price of one drone. The price of the target vessel. The fact that even in failure, what is lost is not human life but a machine.

\$300,000. That is the money it takes to make one Sea Baby. It is the figure reported by 60 Minutes, and several Ukrainian sources have given similar amounts. Send ten of them, and the cost is \$3 million. If only one or two reach the side of a Russian warship, a vessel worth tens of millions of dollars sinks beneath the sea. This is not the arithmetic of a navy. It is the arithmetic of a startup.

A chain of events made this arithmetic real. In April 2022, two Ukrainian Neptune anti-ship missiles sank the Moskva, flagship of Russia's Black Sea Fleet. A Slava-class cruiser, with a crew of about 500, it was the largest and most expensive ship in the Black Sea Fleet. Russia explained it as "an ammunition explosion caused by an

onboard fire and sinking in a storm," but images of the missile strike had already spread around the world.

The Moskva was hit by missiles. But the line of sinkings and disabling strikes that followed belonged to small unmanned boats. In July 2023, the large landing ship Olenegorsky Gorniyak was hit by a maritime drone off Novorossiysk. The same year, near the mouth of the Danube west of Crimea, the missile boat Ivanovets was surrounded by multiple unmanned vessels and sunk. In March 2024, the patrol ship Sergei Kotov sank after a third attack over seven months.

The numbers announced by Ukraine are these. It said maritime drones had sunk or disabled 11 Russian warships. The British Ministry of Defence assessed that by June 2024, at least 26 Russian naval vessels had been destroyed or seriously damaged in the Black Sea. The open-source intelligence group Molnar counted 22 destroyed and 20 damaged between February 2022 and February 2024. Nearly one-third of the Black Sea Fleet's 74 vessels had been disabled.

Once a large ship is built, it is used for decades. A navy's pride, budget, and bureaucracy are inside it. It has a captain, a crew, and a supply system. When one ship sinks, hundreds of trained sailors disappear with it. A maritime drone, by contrast, fails and then the next version appears. The camera position changes, communications equipment is added, more explosives are loaded, and movement patterns are fixed. A warship is a national statue. A drone is a battlefield notebook. It is erased, corrected, and sent back to sea.

The choice made by the drone pilot was not a single charge. It was the act of asking the Russian navy the same question every night. Will you stay in port today too? Will you believe the inside of the breakwater is safe today too? Will you still think a big ship beats a small machine?

4-3 A 940 kg Warhead and a Missile Platform — Next-Generation Maritime Drones and the Arrival of the Unmanned Fleet

Early maritime drones were bombs on the sea. Machines that disappeared together with the target when they touched it. A weapon used once and thrown away, what

military language calls an expendable weapon. But war did not leave this machine as it was.

When Russia built defenses, Ukraine changed the drones. When breakwaters and nets were installed, bypass routes and underwater approach capabilities were added. When helicopters and patrol boats went hunting, machine guns and rockets were mounted.

The next-generation Sea Baby unveiled by the SBU in October 2025 was a different object from the earlier version. According to Newsweek and Reuters, its range had increased to 1,500 kilometers, about 930 miles, and its payload had risen to 2,000 kilograms, about 4,400 pounds. Two variants were unveiled. One had a 14.5 millimeter machine-gun turret equipped with a gyroscopic stabilization system, and the other carried a Grad multiple rocket launcher. In the SBU's official video, it stated, "Each drone is equipped with a 940 kilogram warhead and can penetrate and strike enemy ship defenses."

These changing numbers reveal the nature of Sea Baby. It is not one fixed model but a continuously changing family. The early version was an explosive suicide boat carrying about 850 kilograms of explosives. The intermediate form was an assault type with a 940 kilogram warhead. The latest version became a multipurpose platform that can carry 2,000 kilograms and travel 1,500 kilometers. Parts change, mounts change, and missions change.

In May 2025, something unprecedented in naval history occurred. According to the Ukrainian announcement, a missile launched from a Sea Baby shot down a Russian Su-30 fighter near Novorossiysk. It was recorded as the first case of an unmanned surface vessel bringing down a fighter in the sky. The claim is difficult to verify, but if true, it means maritime drones can even perform air defense.

In March 2026, President Zelensky mentioned "a platform that can launch other drones from a drone." Army Recognition analyzed the statement and summarized Ukraine's vision for the future of maritime drones this way. Strike platform, air-defense platform, intelligence collection and relay platform, and even a mother ship carrying other drones. It is a modular family in which several variants branch off from one basic

hull.

The meaning of the word fleet is changing. The old fleet was a collection of ships carrying captains and crews. The fleet Ukraine is building is a swarm of sensors, communications networks, autonomous movement algorithms, remote operators, and explosive devices. Navies were once born in ports. They needed shipyards, docks, naval academies, and admirals' orders. Ukraine's unmanned fleet was born in warehouses, on workbenches, and from front-line feedback.

In March 2026, the British government signed a maritime drone co-production agreement with Ukraine. The agreement included joint production lines, research and development, cooperation with third countries, and the establishment of an AI Centre of Excellence in Kyiv. An improvised weapon from a poor country had become the subject of an official defense partnership with a NATO member state.

4-4 Striking the Crimean Bridge from Underwater — Why the Black Sea Fleet Disappeared from the Black Sea

The Crimean Bridge was not a bridge. It was a concrete statement that Russia claimed Crimea as its own land. Opened in 2018, the bridge crossed the Kerch Strait and connected the Russian mainland to Crimea. Rail and road traffic passed over it, and so did war materiel, civilian vehicles, and the language of propaganda. Putin himself drove a truck at the opening ceremony.

In July 2023, the SBU's Sea Baby struck that bridge. In an interview with CNN, the SBU confirmed that maritime drones had been used in the operation, and SBU chief Vasyl Maliuk said the maritime surface drones were the SBU's own development. The explosion rose from beneath the bridge. The SBU's official video revealed something even more surprising. "The latest strike on the Crimean Bridge happened in a very unusual way. We struck it from below, from underwater." The drone carried explosives to the lower part of the bridge piers and detonated them underwater. This was the third attack on the Crimean Bridge since the start of the war.

The attack on the Crimean Bridge showed that the targets of maritime drones were not limited to warships. Ports, bridges, tankers, moored warships, coastal air-defense

systems, export terminals. If something touched water or could be approached by waterways, it became a target.

As a result, the posture of the Black Sea Fleet changed. Russian vessels withdrew from Sevastopol farther east, to Novorossiysk. In March 2024, British Defence Secretary Grant Shapps described Russia's Black Sea Fleet as "functionally inactive." The Ukrainian navy announced that Russia was sending almost no warships into the Black Sea.

But the place they withdrew to was not safe either. In November 2025, Sea Baby drones struck and disabled the Russian "shadow fleet" tankers Kairos and Virat in the Black Sea off the Turkish coast. In December, the tanker Dashan was attacked the same way and suffered critical damage. That same December, Reuters reported that the SBU had used an underwater drone called "Sub Sea Baby" to strike a Russian Kilo-class submarine moored in the port of Novorossiysk. It was recorded as the world's first underwater drone attack on a submarine.

According to The War Zone, this submarine was one of six improved Kilo-class submarines operated by Russia's Black Sea Fleet. These submarines carried Kalibr long-range cruise missiles and had repeatedly attacked Ukraine. Even submarines were not safe. Even hiding beneath the sea did not put them beyond the reach of drones. For Russian naval commanders, this must have been a fundamental fear.

It is not an exaggeration to say that a country without a navy drove away a fleet. Ukraine did not confront Russia with a traditional blue-water navy. Instead, it changed where the Russian fleet could stay. As the operating radius of Russian vessels in the western Black Sea shrank, the Ukrainian grain export route that Russia had blockaded also reopened. Control of the sea is not gained only by planting a flag. It can also be gained by making the other side too afraid to enter.

4-5 St. Petersburg, Kronstadt, the Baltic Sea — The Reach Expands

Before dawn on June 3, 2026, black smoke rose above the port of St. Petersburg. Ukrainian drones had flown more than 1,000 kilometers and set an oil terminal on fire.

The timing could not have been a coincidence. That day was the opening day of the St. Petersburg International Economic Forum (SPIEF), Russia's flagship economic event. On the day foreign businesspeople gathered for an event called "Russia's Davos," smoke rose above the city where Putin was born. According to NPR and CNN, in the same attack, the Russian Baltic Fleet missile corvette Boikiy, which was in a dry dock at the Kronstadt naval base, was also hit by a drone. Satellite images showed firefighting teams putting out flames on the hull.

Kronstadt. This name carries heavy weight in Russian naval history. It is the naval fortress built by Peter the Great, the gateway of the Baltic Fleet, and the sea threshold guarding St. Petersburg. The fact that it was attacked was a message beyond tactics. It meant the concept of the "rear" had collapsed.

Three days later, on June 6, a larger attack came. According to Kyiv Post, President Zelensky and Ukraine's Special Operations Forces confirmed that they had struck the Kronstadt naval base again in a joint operation with the SBS, the Unmanned Systems Forces, and the SBU. Drones that had flown about 1,000 kilometers set fires at Russian naval ammunition depots and military facilities. CNN reported that Russian officials described the attack as "unprecedented." The governor of St. Petersburg wrote on Telegram that there had been a "large-scale military drone attack" and said three people were injured.

Zelensky's message was clear. "It is time to end this war. But Russia's leader wants to keep fighting. That is why Ukraine's sanctions against this aggression are working. Last night, our drones flew about 1,000 kilometers to the St. Petersburg region and struck the enemy navy's arsenal and the Kronstadt base."

Two effects overlap in this attack. One is military. Russia must tie down resources for air defense, port security, protection of fuel storage facilities, and dispersal of vessels. Kronstadt is a base whose strategic value for the Russian navy has grown after the Black Sea Fleet was pushed back. Dry docks for warship repairs, submarine facilities, naval training centers, and shipyards are concentrated there. If this place can be pierced by drones, the Russian navy loses a safe maintenance base.

The other is psychological. It plants the perception that the capital region, an economic event, and a naval base are no longer safe stages. When black smoke rises above a city where Putin receives foreign guests, it is not an explosion sound but a caption. War does not happen only beyond the border.

4-6 Targeting Oil Export Infrastructure — Ust-Luga, Primorsk, and Cutting the Arteries of the Russian Economy

The fuel of Russia's war machine is oil. To move tanks, produce shells, run missile factories, and pay soldiers, money is needed. A large share of that money comes from exports of crude oil and refined products. This is why Ukraine attacks Russian refineries and oil export ports. Sinking ships is not the only form of war. Burning the oil that would be loaded onto ships is also war.

In September 2025, the Baltic port of Primorsk, one of the world's largest oil terminals, was attacked. It is the endpoint of Russia's Baltic Pipeline System and a central hub for Russian seaborne crude exports. About 60 million tons of crude oil pass through this port each year on their way to the world. A Ukrainian Security Service source said drones had struck not only Primorsk but also an oil pumping station connected to the nearby Ust-Luga terminal.

In March 2026, the intensity of attacks rose. According to the Kyiv Independent, from March 25 over ten days, the port of Ust-Luga was hit by five drone attacks. The Moscow Times reported that during this period, drones destroyed crude loading facilities, railway unloading platforms, and facilities operated by Transneft. Ust-Luga was a port that exported about 650,000 barrels of crude oil per day. It accounted for about 20 percent of Russia's total seaborne crude supply.

Around the same time, the port of Primorsk, the Kirishi refinery, and the Apatit chemical plant were also attacked one after another. The BBC's analysis of satellite imagery and NASA thermal detection data confirmed that at least eight storage tanks at Ust-Luga, eight storage tanks at Primorsk, and two storage tanks at the Kirishi refinery had been destroyed or damaged.

The results appeared in numbers. According to Reuters' market data analysis, as of March 2026, about 40 percent of Russia's oil export capacity was estimated to have been halted by drone attacks, pipeline strikes, and tanker seizures. Bloomberg reported that there had been days when crude loading at Ust-Luga fell to zero, and Primorsk was also said to have temporarily stopped operations.

A paradoxical phenomenon also occurred. Reuters reported in early June 2026 that crude exports through Russia's western ports had risen to an eight-month high, and the background was this. As refineries were hit by drones and stopped operating, Russia had to push out crude oil itself instead of refined products. Unable to sell processed products, it was sending out raw material at a discount. But port capacity has limits, and drone attacks also touched the ports of Novorossiysk and Tuapse.

Tankers on the sea themselves also became targets. In November and December 2025, according to the Kyiv Independent, Sea Baby drones struck and disabled three tankers in Russia's sanctions-evading "shadow fleet" in the Black Sea. Ukraine described it as a step to reduce Russia's oil income, while Russia denounced it as piracy.

At this point, the meaning of Sea Baby goes beyond sinking one warship. It is a device that changes the cost structure of war. Russia must lay defenses at every port, raise alert levels around every vessel, and recalculate risk insurance for every tanker route. Ukraine sends small machines and creates large costs.

David at sea did not have warships. Instead, he made it impossible for warships to sleep. The Black Sea Fleet retreated, ports became defensive positions, oil terminals became front lines, and tankers became targets. It is too early to say the era of big ships is over. Aircraft carriers and destroyers are still powerful weapons. But the era in which big ships fear small machines has already begun.

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Chapter 5 Soldiers in Hoodies, The Birth of the Unmanned Systems Forces

A man in a black hoodie sat in front of a screen.

A bulletproof vest over a military uniform, and a hoodie over that. In front of him were not operational maps but dozens of laptops. On each screen, shaky footage streamed in from drone cameras. Trenches, ruins, armored vehicles in the mud, a supply truck that had suddenly stopped. On one side of the screen was a table of numbers. Sorties, hit rates, destroyed equipment, costs spent. War no longer moved only at the end of a general's baton. It moved through mouse clicks, antenna angles, battery levels, and the fingertips of pilots steering around radio jamming.

The man's call sign was Madiar.

5-1 Madiar's Trajectory, From Platoon Scale to Branch Commander

His real name is Robert Yosypovych Brovdi. He was born in 1975 in Uzhhorod, western Ukraine. Before the war, he was a grain broker and real estate developer. He had also founded the art patronage foundation BrovdiArt, supporting overseas exhibitions by Ukrainian painters. He was a businessman, a man of culture, not a soldier. He was not the sort of person whose name would appear in a staff college manual.

On February 24, 2022, the day Russia began its full-scale invasion, Brovdi volunteered for military service. He was assigned to the 206th Battalion of the Territorial Defense Forces on the outskirts of Kyiv and became a platoon commander. Irpin, Bucha, Borodianka. In those fierce battlefields, as Russian forces pushed down toward the capital, his platoon evacuated civilians. They had no proper equipment and not enough weapons. What they had was people's desperation and hearts pounding beneath bulletproof vests.

After experiencing combat, Brovdi decided there was something he could do better than sit in a trench. He did not wait for procedure. He began buying drones with his

own money. He bought hundreds of civilian DJI Mavic drones, gathered several dozen pilots, and created a reconnaissance and strike unit called the Birds of Madyar. They hung grenades from civilian drones and dropped them, found the positions of Russian troops, and passed coordinates to artillery. In the early days of the war, drone units began like that, as strange field workshops at the front.

That small group grew. A platoon became a battalion, and the battalion became a brigade. The 414th Strike Unmanned Aerial Systems Brigade, officially the Birds of Madyar brigade, was formed in early 2024. Brovdi moved from front to front. He served with the 28th Mechanized Brigade and the 59th Motorized Brigade, and fought in the battles of Soledar and Bakhmut, the 2023 counteroffensive, and the 2024 Kharkiv offensive. As the record of his drone unit accumulated, the military leadership began to look at him differently.

On May 8, 2025, President Zelensky awarded Brovdi Ukraine's highest honor, the title Hero of Ukraine, along with the Order of the Gold Star. Then, on June 3 of the same year, as Zelensky announced a reshuffle of the military leadership, he appointed Brovdi commander of the Unmanned Systems Forces. Euromaidan Press reported that "the new chief of Ukraine's drone corps had begun a 100-day plan to reshape the skies." A man who had sold grain before the war had become the commander of the world's first Unmanned Systems Forces. There was no such promotion path in the staff college manuals. The battlefield was faster than the manuals.

Before him, the first person to lead the Unmanned Systems Forces was Colonel Vadym Sukharevskyi. He was the founding commander of the organization created on February 6, 2024, and the figure who laid its foundation. The Guardian reported at the time that "Zelensky's army of drones gets its own commander." If Sukharevskyi built the institutional frame, Brovdi filled that frame with the smell of blood from the front.

The project Brovdi put forward as soon as he took office was the Drone Line. The idea was to build a kill zone 10 to 15 kilometers deep along the front, destroying the enemy with drones before they could reach Ukrainian infantry positions. Launched personally by Zelensky, this project became a core doctrine of the Unmanned Systems Forces. The Defense Post described it as an "ambition to maintain a drone-supported combat

zone continuously across the entire contact line."

Madiar's trajectory does not end as one man's rise. The road he traveled resembled the process by which the entire Ukrainian military learned drone warfare. At first, they endured. Then they imitated. Then they modified. And at last they built an organization. It took only three years for trench improvisation to harden into a state institution.

5-2 "We Are 2% of the Defense Forces, but We Destroy One in Three Enemy Targets"

In the spring of 2026, Madiar appeared personally in a recruitment video. Standing before the camera, he recited numbers in a tone closer to a startup founder than a soldier.

"We are 2% of Ukraine's Defense Forces. One in three confirmed enemy targets is being destroyed by the Unmanned Systems Forces. One in three enemy cruise missiles is being shot down by us, and soon it will be one in two."

It is difficult to verify the claim precisely. Announcements by parties to a war always have to be read with caution. But the direction was clear.

On June 4, 2026, Brovdi posted a performance report on his Telegram channel. According to the content reported by Ukrainian News, 358 days after the combat group of the Unmanned Systems Forces was formed on June 11, 2025, confirmed irreversible and medical losses among Russian forces had exceeded 100,000. He wrote that the figure had been verified with evidence stored in the military intelligence awareness system Delta. Beyond personnel losses, 350,000 unique enemy targets had been destroyed, with 1.65 million combat sorties flown, an average of roughly 5,000 sorties per day. The targets hit included 248 air defense systems, 817 tanks, and 1,379 armored vehicles.

The Economist, in a March 2026 profile of Brovdi, presented colder figures. According to a DroneXL report citing the article, December 2025 was the first month in the four years of full-scale invasion when verified Russian losses caused by Ukrainian drones exceeded Russia's new recruitment numbers. During the winter, Brovdi's units killed or

incapacitated at least 8,776 more troops than Russia had replenished. The material cost to incapacitate one person was \$878. The exchange ratio was 400 to 1, meaning 400 Russian losses for every one Ukrainian loss. Brovdi said the cumulative casualty rate within the Unmanned Systems Forces themselves was 1%.

How should these numbers be read?

Combat results announced by a party to war inevitably contain exaggeration. But there is one point outside analysts also acknowledge. The share of strikes carried out by drones in the Ukraine war has grown rapidly since 2024. According to Ukrainian Commander-in-Chief Oleksandr Syrskyi in January 2025, 66% of Russian equipment destroyed that month was destroyed by attack drones. It is difficult to separate exactly how much of that was done by the Unmanned Systems Forces, but it is hard to deny that the war's center of gravity was shifting.

Madiar ran his unit like a business. The Times described his underground command post as a space where "dozens of video screens showed battlefield footage in real time." Pilots worked 12-hour shifts, screens displayed Russian casualty figures in real time, and downed Russian drones hung on the walls like trophies. He said his priorities were to protect his soldiers' lives, provide the equipment they needed, and incapacitate as many enemies as possible.

The expression is uncomfortable. It should be. War is a device that turns human beings into numbers. But from Ukraine's position, this calculation was a cold survival method. Russia had more troops, more shells, and deeper rear areas. A country that could not fight the same way had to change the unit of war. Strike a \$100,000 target with a \$500 drone, and make a multimillion-dollar air defense system waste missiles on cheap decoy drones. The arithmetic was cruel, but it inverted the weight with which a large country pressed down on a smaller one.

The Ukrainian military also introduced a system that converted drone units' combat results into points. Business Insider reported that Ukraine had reshaped target priorities and assigned higher scores for eliminating Russian drone operators. The judgment was that eliminating enemy drone operators had greater ripple effects across the entire front than destroying a tank. Units with high scores received more

drones and communications equipment. A performance pay system had entered the battlefield, but what accumulated was not a bonus. It was the probability of survival.

5-3 The Mission of the Nemesis Regiment, Destroying the Enemy Order of Battle and Breaking Air Defense Systems

The name most often mentioned under the Unmanned Systems Forces is the 412th Nemesis Brigade. Originally formed at battalion scale, then expanded into a regiment and again into a brigade, its official name is the 412th Unmanned Systems Brigade Nemesis. Within it are subordinate organizations such as the Asgard Battalion. Its shoulder patch shows an alien.

To understand Nemesis's mission, one must first understand the concept of an order of battle. An order of battle is the skeleton of an enemy army. Which unit is where, which command post is connected to which artillery unit, and which sky an air defense radar is watching. If that skeleton is broken, the muscles of the front lose their strength.

In an in-depth interview with the Kyiv Independent, one Nemesis commander explained it this way. "There are brigades that hold the defensive line. Their task is to hold the line and prevent the enemy from advancing. Our task is different. We help them by destroying the order of battle behind the defensive line, farther away."

The list of targets he named was specific. Infantry, mortars, howitzers, self-propelled artillery, air defense systems, and enemy drone launch sites and operators. Among them, the first priority was Russian drone pilots. "We find and destroy the locations of enemy pilot crews. That is the first objective." In drone warfare, killing the drone operator first is like blinding an opponent in chess.

Breaking air defense systems came next. To attack ammunition depots, supply warehouses, command posts, and oil facilities in the Russian rear, drones must travel a long way. Along each route stand radars and Pantsir, Tor, Buk, and S-300-series air defense systems. The whole sky is a trap. Without first stabbing the eyes and ears of that trap, long-range strikes are impossible.

Nemesis's record remained in numbers. United24 Media reported that in the first five months of 2026, Ukrainian unmanned systems units struck 174 Russian air defense assets. The figure included surface-to-air missile systems, radar stations, and electronic warfare equipment. The Unmanned Systems Forces estimated that Russian damage in this category alone exceeded \$5.4 billion, roughly 7.5 trillion won.

Ukrainska Pravda published an interview in May 2026 with Pavlo Laktionov, deputy commander of the Nemesis Brigade. According to him, as of May 2, 2026, the Nemesis Brigade had destroyed or struck 83 enemy air defense systems. The number included Tor, Buk, and S-300-series radar stations. He added that "the rate of destruction exceeds Russia's rate of production."

These numbers must be read with the limits of wartime announcements in mind. Independent verification has not been carried out in every case. But what Ukraine is aiming at was clear. It was moving away from a war of destroying one tank at a time, toward a war that made the enemy unable to see the battlefield, unable to block attacks, and unable to connect its forces.

Ukraine's Ministry of Defense also announced that 81 Russian air defense systems had been confirmed neutralized since March 1, 2026. In January of the same year, the Nemesis Asgard Battalion destroyed eight air defense systems in one month, including a radar from the S-350 Vityaz system. ArmyInform, a military intelligence outlet, reported that the damage from that month alone exceeded \$250 million. Euromaidan Press reported that in the third week of January alone, 10 air defense assets had been destroyed, causing roughly \$300 million in damage.

The reason for striking air defenses first is cold. First stab the eyes and ears of the Russian military, then send deeper strike drones into that blind spot. The tactic of mixing decoy drones, reconnaissance drones, suicide drones, and electronic warfare equipment to exhaust Russian air defenses had already taken shape. Kyiv Post reported that Ukrainian intelligence was using large numbers of deception drones together with live munitions in long-range air raids to wear down Russian air defenses.

5-4 A Recruitment Notice for 15,000, Electronics Engineers, Programmers, Designers, Drone Pilots

Organizations grow by consuming people.

On April 29, 2026, Ukraine's Ministry of Defense officially announced large-scale recruitment for the Unmanned Systems Forces. 15,000 people. The recruitment notice, reported at once by military specialist outlets including The Defense Post, Airforce Technology, and Naval Technology, was different from old-style military recruitment.

The targets were not only drone pilots. Electronics engineers, programmers, 3D designers, project managers, OSINT analysts, camouflage specialists, IT specialists, medics, and drivers. As Madiar said in the recruitment video, half of the vacancies were "civilian professional jobs in peacetime that are needed on the front right now."

These personnel were to be assigned to the Drone Line project. According to a Ukrainian Defense Ministry announcement reported by GlobalSecurity, the Drone Line aims to "build an integrated system for the systematic operation of unmanned systems, provide aerial support to infantry, and continuously engage the enemy at depths of 10 to 15 kilometers." The ministry said that within one year of launch, units under or supported by the Drone Line had neutralized one in four battlefield targets.

A recruit training system was also in place. Civilians received basic military training and then completed specialized unmanned systems courses at three dedicated training centers. There was a basic military training program developed separately for the Drone Line, with heavy emphasis on practical training.

A change in wartime recruitment notices means a change in the military imagination. Armies of the past first looked for physically strong young men. The army in this war looked for people who knew how to solder, read circuits, fix code, and calculate antenna angles. The engineering lab had entered the barracks. People wearing bulletproof vests over combat uniforms and hoodies over the vests became the new face of war.

In the Kyiv Independent interview, the Nemesis commander described the scene this way. "A gamer in a hoodie who vapes, that's probably 70% of the Armed Forces of Ukraine. We have more, about 90%. This is the typical portrait of young people today, and as long as they are not in actual combat, we are as democratic as possible in style and dress."

Madiar's recruitment video had a slogan. "Running around is good, but it's time to fly. While destroying the occupiers." He added, "Enter the three letters C5C online and join one of the 12 bird units." Units under the Unmanned Systems Forces were known by nicknames named after birds. Eyes and sting. The terror of Kropy, the Ukrainian nickname for Russia's Shahed cruise missiles. For a war recruitment poster, it had an odd touch of humor.

The drones are waiting for pilots, not the other way around. A slice of the war was contained in that sentence. Ukraine's drone production capacity had already surpassed the speed at which it could supply operators. Machines overflowed, people were short. The war of 2022 lacked rifles, the war of 2024 lacked shells, and the war of 2026 lacked pilots. What the war demanded was changing.

5-5 The Business Approach, Efficiency Metrics, Standardization, and the Arithmetic of \$878

The philosophy running through the Nemesis Regiment and the Unmanned Systems Forces as a whole could be summed up in one phrase, the business approach.

In the Kyiv Independent interview, the Nemesis commander used the phrase directly. "We tried to apply a business approach to all kinds of military processes. Breaking everything down into business processes with efficiency indicators and solutions that can be standardized and regulated."

If the language of the traditional army was courage, orders, positions, and shelling, the language of Madiar and his commanders was metrics, feedback, output, and scalability. An Excel sheet had been spread over the trench. It is hard to laugh it off when it is an Excel sheet smelling of blood, but in this war, such tables separated life from death.

According to The Economist's analysis cited by DroneXL, the material cost for the Unmanned Systems Forces to incapacitate one Russian soldier was \$878. Tracing how that number was produced reveals the arithmetic of asymmetric war. FPV drones costing \$300 to \$500 are the main weapon. Add the cost of reconnaissance drones and communications equipment, and the cost per sortie can be calculated. That cost is then divided by confirmed enemy losses.

The 400-to-1 exchange ratio reported by The Economist was an even more striking number. According to Brovdi's own calculation, 400 Russian losses for every one Ukrainian loss. The Unmanned Systems Forces' cumulative casualty rate of 1% was dramatically low compared with casualty rates in frontline infantry units. Drone pilots hold the controls several kilometers away from the front.

This pursuit of efficiency had an uncomfortable side. Scoring wartime performance, ranking units, and calculating the cost of killing one enemy cannot escape criticism that human life is being converted into ledger entries. The Times reported that Brovdi's unit's release of drone strike videos for use in psychological warfare had caused ethical controversy. Drones save soldiers' lives while also lowering the threshold for killing. A pilot looks at a screen and presses a button, but beyond the screen is a person.

Ukraine's reality may explain the choice, but it does not erase its weight.

Still, the need for standardization itself was hard to deny. The early stage of drone warfare was a wild workshop. Each unit bought drones separately, modified them separately, attached explosives separately, and learned to fly them separately. If battery standards differ, video transmission equipment differs, and explosive mounting methods differ, mass production and mass training become impossible. The birth of the Unmanned Systems Forces was an attempt to pull this wildness into an institution. To turn inventions from the front into the system of a military branch. To turn drone workshops into logistics networks. To turn pilots' instincts into manuals.

The Nemesis commander acknowledged that tension honestly. "Of course, we all understand that some doctrines and regulations were written long ago. Even if they were written relatively recently in independent Ukraine, they have already lost relevance. History is being made right now. The future has already arrived, and

documentation is low on the list."

A war in which manuals cannot catch up with reality. A war in which feedback from the front is faster than documentation. Within that speed, the business approach served as a temporary skeleton filling the empty space left by manuals.

5-6 The Expansion of Deep Strikes, In 2026, Organization Catches Up With the Speed of the Battlefield

As 2026 began, the strike range of the Unmanned Systems Forces became visibly deeper.

Reuters reported in May 2026 that Ukraine's Ministry of Defense had carried out more than 160 medium-range strikes at distances of 120 to 150 kilometers during the month of April. The targets were more than 65 logistics and ammunition sites, 33 drone control posts and workshops, and 17 troop command posts. This was not a war of hitting tanks just in front of the line. It was a war of cutting the devices that kept the war moving behind the front.

Euromaidan Press reported that the Unmanned Systems Forces were carrying out more than 100,000 combat sorties per month and would expand medium-range and deep-strike units beginning in May 2026. News also emerged that German and Ukrainian companies were pursuing joint production of long-range drones with ranges of up to 1,500 kilometers. The defense outlet Defence Express reported that the 1st Independent Center of the Unmanned Systems Forces, in coordination with the Deep Strike Center, had struck more than \$120 million in Russian air defense assets in less than a week.

The core of this change lay in the transformation of organizational structure. A system had been put into combat that linked intelligence decryptors, data analysts, aerial reconnaissance teams, and drone strike teams into a single chain for rapid decision-making. The process described by the Nemesis commander to the Kyiv Independent was this. "An analyst analyzes the enemy's use of unmanned equipment and determines search areas for aerial reconnaissance. Aerial reconnaissance flies out and searches. That data is processed by decryptors and analysts. They determine

altitude, radio horizon, and possible points. Then drone strike teams are sent to the designated points."

The shorter the chain from analysis to strike, the less time the enemy has to respond. A strike must arrive before a Russian air defense system changes position. In this contest of speed, bureaucratic procedures were fatal.

Brovdi also reorganized the command structure soon after taking office. Euromaidan Press reported on March 31, 2026, that Brovdi had appointed two field commanders who had received the Hero of Ukraine title to senior staff positions in the Unmanned Systems Forces. Their assigned task was "to build a continuous Drone Line across the entire contact line." That same month, the Unmanned Systems Forces released their March performance: 10,477 enemy troops killed and 37,627 unique enemy targets struck. Brovdi left a sentence on Telegram. "In April, the conductors and pilots of CBC are preparing a new symphony."

Places far from the battlefield were no longer safe. AP reported in June 2026 that Ukrainian drones had struck oil facilities in Russia and Crimea. Refineries, ports, ammunition depots, and military airfields hundreds of kilometers from the front had entered drone range. The very concept of the "rear" was shaking.

This war industry did not wait only for the delivery schedules of large defense companies. It became a huge laboratory where startups, donors, military units, software developers, and field pilots all rushed in at once. Reuters reported that Ukraine and related startups were developing maritime drones, ground robots, and long-range drone systems at unprecedented speed.

And Russia was coming fast too.

Euromaidan Press reported in May 2026 that in an interview with Ukrainska Pravda, Brovdi warned that Russia was effectively copying Ukraine's Unmanned Systems Forces model. According to Brovdi, Russia was rapidly increasing the number of drone operators, mass-producing cheap strike systems, and even imitating Ukraine's organizational structure. According to remarks by Commander-in-Chief Syrskyi reported by the Kyiv Independent, Russia planned to form unmanned systems forces

of 210,000 personnel across 277 units by 2030.

Business Insider relayed Syrskyi's warning that Russia intended to raise the share of faster jet-powered Shahed-series drones in long-range attacks to 50%. Ukraine did not create the Unmanned Systems Forces to show off innovation. It did so because the opponent was running in the same direction.

What Ukraine had in this competition was time. It had started first, failed first, and learned first. Russian drone volume was six times Ukraine's, but the Unmanned Systems Forces claimed their drones were qualitatively ahead. No one could guarantee how long that gap would last.

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The birth of the Unmanned Systems Forces is not a story about the Ukrainian military buying many drones. It is a story about a change in military structure.

A new compartment appeared between the old compartments of infantry, artillery, armor, air force, and navy. But this compartment was not separate from the others. Drones were the eyes of artillery, the spear of infantry, the torpedoes of a country without a navy, and bombers for places the air force could not reach. The Unmanned Systems Forces were one branch, and at the same time the nervous system of every branch.

At the center of this change was the hoodie. A hoodie is not a military uniform. It is closer to the clothes of an overnight developer than a uniform with stars shining on the shoulders. But this war placed that hoodie beside the uniform. A drone pilot was a combatant even without sitting in a trench, and a programmer was part of the front even without holding a rifle. Hands holding soldering irons and hands holding joysticks entered the same war as hands holding rifles.

The process was not smooth. Manuals panted as they tried to catch up with reality, and there was always tension between standardization and creativity in the field. Psychological warfare through the release of videos caused ethical controversy, and performance scoring carried the risk of making war look like a game. Batteries were short, signals were cut, and Russian electronic warfare grew stronger by the day. A new

model became an old model within a week. War did not give enough time to press the update button.

Still, the birth of this organization had already changed one thing. When a small country fights a large country, matching the same kinds of weapons in the same numbers is not the only path. An army can be a mass of steel and gunpowder, and at the same time a living organism of software and production networks.

A black hoodie, laptops, antennas, joysticks, and a shaking horizon on a screen.

There, the world's first Unmanned Systems Forces were born.

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Chapter 6 AI Does Not Hold the Sight, The Boundary Line of Autonomous Weapons

6-1 AI's Current Role, Codebreaking, Analysis, Bypassing Electronic Warfare, 3D Model Recognition, and Target Detection Support

In a small room near the front, a soldier stares at a screen. On it, forest and muddy roads, the shadow of a burned-out armored vehicle, and the roof of a broken house are mixed together. He is holding a joystick, but he is not looking alone. There is another eye beside him. An eye that does not tire, does not blink, and does not grow bored even after seeing the same scene thousands of times. AI.

But this AI is not yet the soldier pulling the trigger. It classifies first. It judges whether a dot on a dirt road is a person, a motorcycle, or a shell transport vehicle. When electronic warfare shakes the video feed, it holds on through the last few hundred meters. Even if a drone loses its connection with the pilot, it keeps following the target in the camera. Both Ukraine and Russia are mounting AI-based image-recognition devices on drones, trying to track targets even under heavy radio interference. Ukraine still says a human is needed to approve an attack. That statement is a technical explanation and, at the same time, a political line of defense.

AI also works behind the battlefield. It classifies intercepted communications, searches for patterns in encrypted signals, and stitches together satellite images and drone footage. It looks for air-defense networks, supply roads, and artillery hidden along the edge of a forest. In an interview with the Kyiv Independent, the commander of the Nemesis Regiment explained it this way. "Of course, we use artificial intelligence in our work. In decryption and analysis." AI mounted on drones has reached the point where it can learn 3D models of enemy aircraft and identify parked aircraft on a runway by itself. The FPV drones used in Operation Spiderweb used this very method to distinguish Tu-95 strategic bombers from Tu-22M3 bombers and strike them.

The core of the technology is not a grand humanoid robot. It is one small chip, one camera, one software update. It reads the outline of an object that enters the frame, compares it with 3D shapes it has already learned, and predicts movement. A person says, "Look at that," and AI calculates, "What is that most likely to be?"

In a March 2025 report, CSIS, the Center for Strategic and International Studies, showed this process with concrete numbers. Drones equipped with AI autonomous navigation achieve target-strike success rates of 70 to 80 percent. Compared with the 10 to 20 percent success rate of manually piloted drones, the difference is three or four times. When a person pilots with a joystick, eight or nine drones were needed for one target. If AI guides the final 100 to 1,000 meters, one or two are enough. That is because AI detects electronic-warfare jamming zones and sets bypass routes by itself.

But here the boundary grows thin. If a pilot chooses the target and AI guides the last 500 meters, is that a human attack or a machine attack? If a human presses the approval button, but the information on the screen is filled with AI recommendations, whose judgment is it? The battlefield does not ask questions with the clarity of a courtroom. The video shakes, time shrinks, and enemy electronic-warfare equipment bites into communications. In that gap, AI moves forward little by little, from assistant to aim corrector, from aim corrector to de facto shooter.

In 2026, Ukraine took one step further. It announced that it would open a platform providing battlefield data to train allied AI models. This includes footage gathered from combat flights, annotated images, and data for analysis. War now demands not only ammunition depots but data warehouses. Ukraine's battlefield has become the world's largest AI training ground, and inside it, new algorithms are tested every day.

6-2 "Decisions Should Always Be Made by People", A Principle of Effectiveness or a Principle of Ethics?

"Decisions should always be made by people."

The sentence sounds like a declaration. But for a soldier at the front, before it is a sentence from an ethics textbook, it is a sentence about survival.

In the Kyiv Independent interview, when the commander of the Nemesis Regiment was asked why this principle mattered, he gave an unexpected answer. "First, it is about the effectiveness of the work. We have to know what we are striking. If a person is sure that this is a target, they can give the order to destroy it." Effectiveness came before ethics. If AI misreads a target, a friendly vehicle can become an enemy armored vehicle, and a civilian car carrying wounded people can look like a logistics truck. Dust, smoke, snow, nighttime thermal imagery, and broken terrain are different from the clean data the model has learned. Battlefield data is always stained.

The statement that a human must make the final judgment is a standard meant to protect civilians and, at the same time, a tactical device for reducing malfunction. Humans still read context. A person waving a white cloth, a wounded person lying beside an abandoned vehicle, a soldier fleeing after taking off his uniform, a combatant hiding behind civilians. These scenes are not a matter of pixels. They are judgments in which the law of war, field instinct, fear, and responsibility are tangled together. AI is fast, but speed is not the same as being right.

International discussions hold the same line. In his 2023 "New Agenda for Peace," UN Secretary-General António Guterres urged that a legally binding instrument banning lethal autonomous weapon systems, or LAWS, operating without human control or oversight, should be completed by 2026. He went so far as to say that giving machines the power and discretion to take human life is "politically unacceptable and morally repugnant." In December 2024, the UN General Assembly adopted a resolution on lethal autonomous weapons by a vote of 166 to 3, with Russia, North Korea, and Belarus opposed. The resolution contained the so-called "two-tiered approach," calling for a total ban on some autonomous weapons and regulation of the rest.

But soldiers do not read this sentence only as ethics. They also read it as a principle of effectiveness. Ukraine emphasizes the principle of human approval for several reasons. It is the language of trust directed at Western supporters, a device for avoiding controversy over violations of international law, and a practical way to reduce battlefield failure. The CSIS report, in assessing Ukraine's AI warfare capabilities, also analyzed that fully autonomous warfare remains closer to a goal and that partial

autonomy and human oversight are the core of the present. "We are very far from killerrobots." That is what Kateryna Bondar, the author of the report, said in an interview with Breaking Defense.

But this sentence comes under increasing pressure as time passes. Electronic warfare cuts communications, a drone loses its target, and a Russian military vehicle disappears onto a forest road in a matter of seconds. The pilot loses the screen. At that moment, AI says, "I will keep following." The human approved it, but the final judgment has already entered the speed of the machine.

6-3 Fiber-Optic Drones Versus AI Autonomous Drones, Two Roads Toward Immunity from Electronic Warfare

On a battlefield where radio waves have died, two roads have appeared. One is the road of holding on to a line. The other is the road of cutting the line.

A fiber-optic drone flies while unwinding a thin line behind it. A cable thinner than fishing line physically connects the pilot and the drone. It is not a wireless signal, so radio jamming does not work. The video is clear, and control does not break. Both Russia and Ukraine are using this method to pierce electronic-warfare zones. The Atlantic Council explained that fiber-optic drones can provide precise strikes and clear imagery at distances of more than 30 kilometers and are, in effect, immune to radio interference. In February 2025, fiber-optic drones were used for the first time in civilian areas on the outskirts of Kharkiv.

But a line has the fate of a line. The cable can tangle, and it adds weight. Wind, trees, utility poles, and the steel bars of ruins become enemies. To gain longer range, a larger reel is needed, and a larger reel makes a more sluggish drone. The commander of the Nemesis Regiment admitted this point plainly. "If a fiber-optic drone successfully reaches the target and there is enough fiber, yes, this is a big problem. But it has its own limitations. We cannot say fiber-optic drones are a panacea."

AI autonomous drones go in the opposite direction. Even if the connection with the pilot is cut, they remember the target and follow it. An image-recognition model holds on to the outline of a vehicle, trench, or turret in the camera feed. The Nemesis

commander also pointed to this evolutionary path. "Before fiber optics began to be used at scale, people expected that the main solution to electronic warfare would be autonomous drones with artificial intelligence. And perhaps we are slowly getting there."

Fiber-optic drones choose "a connection that does not break." AI autonomous drones choose "the ability to keep going even after the connection breaks." One is the wired telephone of the battlefield, and the other is an arrow with memory. Which side gains the advantage depends on terrain, distance, target, cost, and production speed. As electronic warfare grows stronger, both technologies grow together.

But the point where these two roads merge is already appearing. In late 2025, the Ukrainian Navy released footage of fiber-optic FPV drones being launched from the internal hangar of a Magura-class naval drone. From a mother ship that is itself a naval drone, electronic-warfare-immune drones rise into the air and strike targets beyond the shoreline. A drone that holds the line and a drone that cuts the line. They look like opposites, but they were born from the same desire. The desire not to lose a target even where the pilot's hand cannot reach.

6-4 Drone Swarms, Drones Working Together Like a Swarm, and What Comes Next

One drone is an eye. Ten drones are a net. A hundred drones become weather.

The fear of swarm drones does not come from the performance of each individual drone. It comes from the fact that they move together. The leading drones find air-defense networks, the following drones enter through gaps, some become decoys, and some become explosives. Air-defense radar counts targets, but when the targets become too many, the number itself becomes a weapon.

In a March 2026 report titled "The Coming Compute War in Ukraine," the Atlantic Council presented the following scenario. On the Kharkiv front in May 2026, a Ukrainian commander launches 800 autonomous drones. Aerial drones and ground drones move together, paralyzing enemy air defenses, identifying and striking artillery positions, and pushing into gaps in the Russian front line. The operation depends on

real-time coordination. Sensors hand target data to strike platforms, movement algorithms synchronize the speed of advance, and machine-learning systems adapt to Russian responses.

This is a hypothetical scenario, but reality is already at its threshold. IEEE Spectrum reported that, as of early 2026, thousands of ground robots were moving through the gray zone of the Ukrainian front. Most are for carrying supplies or evacuating the wounded, but "killer" ground robots equipped with machine-gun turrets are also being tested. In December 2025, near the village of Lyptsi north of Kharkiv, the first fully unmanned operation was carried out against Russian positions using only dozens of unmanned ground vehicles and FPV drones, without infantry. In this operation, confirmed by the CSIS report, ground robots handled mine clearance, direct fire, and ammunition transport, while FPV drones provided aerial support. Surviving robots returned to Ukrainian positions after the operation.

The same trend is visible at sea. Reuters reported in early June 2026 that a formation of roughly ten autonomous maritime platforms was planned for deployment to defend waters near Odesa, with an initial operating goal of early 2027.

Swarmer, a company leading Ukraine's swarm-drone technology, raised \$15 million in Series A funding led by U.S. investors in September 2025. It was the largest single investment in a Ukrainian defense technology company since the war began. Swarmer CEO Serhii Kupriienko said this. "Our software has proved itself in tens of thousands of real combat missions. Western democracies should be able to field as many drones and robots as they can produce, unconstrained by the number of trained pilots." Swarmer said it used data from more than 82,000 of its own combat missions and millions of flights conducted by other units for training.

AI is essential to a swarm. It is impossible to hold and pilot every drone one by one. AI shares positions among them, avoids collisions, distributes targets, and if some are shot down, changes the routes of the remaining drones. A person gives the overall mission. "Reconnoiter that area." "Paralyze that air-defense network." "Block that sea area." The detailed coordination that follows happens among machines.

Here the boundary shakes again. Is it human control because a person gave the mission? Or is it an autonomous attack because the swarm decided the individual target selection and attack sequence? A swarm blurs responsibility. If one drone misfires, it can be investigated. If a hundred drones moved at once and thirteen of them took different routes, it becomes hard to find who made the wrong judgment, and at what moment.

6-5 "They Will Not Care About This Problem", When Russia and China Run Without Ethical Constraints

The interviewer asked the commander of the Nemesis Regiment: on one hand, there is the ethical issue that a human must be included in the process; on the other, there is the argument that Russia and China will not care about such problems. What would he advise Western militaries?

The commander's answer was clear. "First, we are not responsible for Russia or other countries. We are responsible for our army, our defense forces, our units. Our policy is built in such a way that we, I repeat, use a person's decision, and not just any person, but the person responsible for this process."

There is something missing from this answer. What should be done when the other side does not follow the rules? The commander stated the principle of his own unit, but did not speak about a response to the enemy's choices. That is probably not a question answerable at his level.

But reality is not divided into black and white. The Lieber Institute at the U.S. Military Academy, West Point, has analyzed the positions of China and Russia on autonomous weapons. In discussions under the UN Convention on Certain Conventional Weapons, or CCW, China has argued that lethal autonomous weapons must remain under meaningful human control in order to satisfy international humanitarian law. The Lieber Institute analyzed, however, that China's discussion of military AI ethics leans toward leaving room for country-specific interpretation and strategic flexibility rather than universal norms. That is why the phrase "human oversight with Chinese characteristics" appears.

Russia shows a more open contradiction. It takes a minimalist position that existing international humanitarian law is enough, while actively deploying AI-supported weapons systems on the actual battlefield. According to CSIS's April 2026 report, "How Russia Is Building a Sovereign Drone Ecosystem for AI-Driven Autonomy," Russia aims to complete by 2030 an ecosystem covering the entire cycle of unmanned aerial vehicle design, production, and operation, and plans to fill 70 percent of its domestic market with Russian-made drones. The plan also includes training 15,500 AI specialists each year and equipping 80 percent of the workforce with basic AI literacy. Russia speaks of human control while racing toward autonomy. In the December 2024 UN General Assembly vote on the autonomous weapons resolution, Russia stood with North Korea and Belarus as the only three countries opposed.

The problem lies in how far democratic states can go when the other side does not follow the rules. War always creates a slope toward the lower side of morality. If one side fires faster without human approval, the other says, "We cannot be the only ones who are slow." If one side releases swarm drones over a city, the other says, "Even for defense, we need the same technology."

In February 2026, France, Germany, Italy, Poland, and the United Kingdom launched the Low-Cost Effects and Autonomous Platforms initiative, abbreviated LEAP. Its purpose is to jointly produce low-cost air-defense systems and autonomous drones based on Ukraine's battlefield experience. The fact that five of Europe's major military powers put the word "autonomous" in the name of the initiative tells us the direction.

The line of prohibition does not disappear. It only moves farther back.

6-6 The Moment the Speed of War Overtakes the Speed of Human Judgment

Someday, battlefield screens will show simultaneous events moving at a speed difficult for humans to follow.

Three vehicles move along a northern forest road, a heat signature appears in a western trench, a group of Russian drones comes in low from the southern sky, and the communications network cuts out, reconnects, and cuts out again. An air-defense

battery gains two seconds to fire one shot, and a drone pilot loses one second to confirm a target. At that moment, AI does not wait. It calculates.

The commander of the Nemesis Regiment described the speed of change in war this way. "Before, it changed more slowly. Once a year, once every six months. Now any tactical change can happen in just a few months. After only one or two months, there may already be a change." If the innovation cycle of war has reached this point, what about the execution speed of war? This is a battlefield where thousands of drones combined from both sides sortie each day, enemy movements are monitored in real time, and the time from reconnaissance to strike has shrunk to minutes.

In September 2024, Robert Brovdi, commander of Ukraine's special drone unit "Madyar's Birds," went one step further in a conversation with *The Economist*. Within six to eight months, he said, Ukrainian drones would no longer need pilots at all. "You only have to launch them. The drone will decide by itself where to go and how to strike the target." He added that hundreds of AI systems were being developed and tested.

It is difficult to confirm whether this forecast came true on that timetable. Battlefield technological progress is always slower than announcements in some areas and faster than announcements in others. But the direction is clear. According to the CSIS report, the Ukrainian military set a goal of equipping at least half of the drones it purchased in 2025 with AI guidance. Compared with 2024, when AI-guided drones made up 0.5 percent of the total, that is a hundredfold increase.

At the moment the speed of war overtakes the speed of human judgment, human control demands a new meaning. The mere fact that there is a person pressing a button is not enough. We must ask what the person knew when pressing it, whether there was time to refuse, and whether there was both the authority and the actual room to doubt the AI's recommendation. When the screen is too fast, the recommendation too forceful, and the cost of failure too great, the human becomes not a controller but a ritual procedure. Like a stamp placed in front of the sight.

Before the end of 2026, the Group of Governmental Experts under the UN Convention on Certain Conventional Weapons must finalize a draft of norms on autonomous weapons. But on the battlefield, new software is uploaded to drones every day, new

autonomous-navigation algorithms are tested every week, and every month more drones need the human hand a little less. The international community speaks of human control, and the battlefield speaks of speed. Whether those two languages can remain inside the same sentence is still unknown.

The boundary line of autonomous weapons cannot be closed with one sentence: "Did AI kill a person?" Did AI choose the target? Did AI maintain the target? Did AI change the final route? Did the human understand the process? Could the human stop it? If the human did not stop it, can the human take responsibility? Only when these questions overlap does the line finally begin to appear.

We can still say that AI does not hold the sight. But it is already choosing the scene inside the sight, correcting the shaking hand, and continuing to follow the target behind a broken signal. A thin gap has opened between the trigger and the eye, between human judgment and machine calculation. The autonomous weapon of the future is born in that gap.

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Chapter 7 The Invisible War, The Front Line of Electronic Warfare and Computing

7-1 "There Will Be No GPS", A Battlefield Ruled by GPS Jamming and Spoofing

The drone pilot was watching the screen. The field was still there. So were the woods, and the shadows on the road. But the dot on the map began to slide strangely. The drone was moving forward, yet its coordinates drifted sideways. A moment later, the aircraft began to respond late to commands. The stick was pushed, but the reaction was sluggish, and the video broke apart like snow. There was no gunfire. No explosion. The battlefield attacked in silence.

In the war in Ukraine, electronic warfare, attack and defense using radio waves, has become invisible artillery. Shells turn over the soil, but jamming turns over the sense of direction. Cut off the GPS signal, and a drone no longer knows where it is. There is an even more insidious method. Spoofing does not cut the signal; it shows a false road. The drone does not even know it is lost and trusts the wrong coordinates. A 2025 TechRxiv analysis reported that Russian electronic warfare systems such as Krasukha-4 and Borisoglebsk-2 neutralized Ukraine's Bayraktar TB2 drones in this way from the early stages of the war.

A few days ago, this invisible war erupted into a visible accident. On the morning of June 5, 2026, a naval drone exploded in the Romanian port of Constanta. It was a few hundred meters from an oil terminal. There were no casualties, but Romanian authorities evacuated more than 1,000 people from the beach. According to the Kyiv Independent, the Ukrainian Navy explained that one of its drones lost control after being disrupted by Russian electronic warfare while operating in the Black Sea, then drifted toward the Romanian coast. It added that Romania had been warned in advance, preventing loss of life. Reuters described the incident that day as "the second major incident in a populated area on NATO's eastern flank in a week." A week earlier, a Russian-made Shahed-type drone had struck an apartment building in the

Romanian city of Galati, injuring two people.

Electronic warfare does not stay on the front line. It pushes its shadow as far as an oil terminal in the port of a NATO member state. Greece also protested to Kyiv after a Ukrainian naval drone was found near one of its islands. A machine whose radio waves have been disrupted does not know borders.

The reaction Western soldiers showed when they first encountered this reality was surprisingly naive. The commander of the Nemesis regiment described one such scene in an interview with the Kyiv Independent. Western military officials brought in a new drone system developed in their own country and asked, "How do you think this can be used?" The commander was not an engineer, but he had experience. "How does it work? How is the connection secured?" After hearing the answer, he said, "None of it will work." They pushed back. "We have GPS." The commander's reply was short. "There will be no GPS."

"Why will there be no GPS?" "There are satellites." "It will be jammed. There will be no GPS." Then the other side hesitated. "I don't know what will happen next."

After some time, they came back. This time they brought equipment that amplified GPS signals. "This equipment will reinforce GPS." The commander said, "We used that equipment a year and a half ago. Today, those things don't work." The other side sighed. "Damn it, we bought hundreds of them."

The moment a combatant can no longer trust GPS, much of the equipment of modern war returns to older senses. Maps, terrain, inertial navigation, or INS, which estimates position with gyroscopes and accelerometers, visual recognition, pre-entered coordinates, and the pilot's intuition. In a video released in 2025 by Mykhailo Fedorov, Ukraine's Minister of Digital Transformation, a drone continues its mission along a pre-entered route using inertial navigation even after GPS signals disappear. The battlefield has become a strange place where cutting-edge equipment walks into a medieval fog.

"There will be no GPS" is not a complaint about technological failure. It is now an order to prepare for combat.

7-2 Frequency Hopping, New Transmitters, Hacking, The One-Week Cycle of Invisible Attack and Defense

The speed of electronic warfare is different from the speed of a munitions factory. There is no time to cut new molds and wait for mass production. The frequency that worked yesterday is blocked today, and the transmitter that survives today is detected next week. Near the front line, the smell of solder and coffee rises from the same workbench.

FPV drone pilots say, "It cut off here." Engineers answer, "Then let's change this part." An operational report soon becomes a product improvement request. This cycle of feedback and modification takes roughly one week. According to 60 Minutes, from the moment an FPV drone is sent to the front line, it takes about a week to collect field feedback, modify the software, change the frequency response method, produce a new version, and send it back to the front.

Frequency hopping, a technology that communicates by rapidly switching frequencies, is the basic grammar of this contest. Stay on one frequency too long, and you get caught. So you must keep jumping. But the side that jumps is not the only one evolving. The side that catches also jumps. It monitors wider bands, reads patterns faster, and finds smaller signals.

Military Machine's April 2026 analysis shows the result of this contest in numbers. Ukrainian FPV drone pilots recorded a 40 to 60 percent hit rate under favorable conditions in 2023. But by mid-2024, in areas where Russian electronic warfare was heavily deployed, the hit rate fell below 20 to 30 percent. Russia had turned the electromagnetic spectrum itself into a hostile environment.

Ukrainian engineers did not try to punch through Russian jamming with stronger radios. They moved toward removing the vulnerability itself. They bypassed radio frequencies altogether with fiber-optic cables, or tracked targets without GPS using AI visual recognition systems. A 2025 CSIS analysis also explained that drones on the Ukrainian front were being rapidly built from commercial components, and that the move toward fiber-optic control to avoid electronic warfare was clear.

GIS Reports, in a May 2026 report, pointed to the difference in the two sides' approaches. Russia relies on scale. It saturates signal space by deploying large numbers of high-power jammers across the entire front. Ukraine relies on innovation. It raises precision and adaptation speed through a distributed network of civilian engineers. The difference in hardware reveals a difference in strategic culture.

In this scene, a soldier no longer handles only a gun. He reads the state of signals. An engineer is no longer support personnel in the rear. He is inside the rhythm of combat. A hacker sits in an office, but his keyboard is connected to equipment beside a trench. The front line is not drawn only across soil. It is drawn across frequency tables as well.

7-3 Why Fiber-Optic Drones Are Not a Cure-All, The Limits of a Technology Both Sides Are Developing

Fiber-optic drones were a slender counterattack that appeared in the middle of electronic warfare. Because they do not use wireless signals, jamming does not work on them. Behind the drone, a glass fiber thinner than a hair unwinds. Control commands and video travel along that line. The moment a flying machine looks like a kite tied to a string, the battlefield binds past and future into one body.

In a Ukrainian military test video reported by RFE/RL in March 2025, a fiber-optic drone flew at 60 kilometers per hour, and the fiber did not snap within a range of 10 kilometers. Even when flying low between buildings and through woods, the signal does not cut out. Areas that had once been safe have now entered strike range.

But the commander of the Nemesis regiment drew a clear line in his Kyiv Independent interview. "We cannot say fiber-optic drones are a cure-all." The line has a limit in length. It winds up, breaks, and catches on terrain. Urban debris, woods, utility poles, barbed wire, and vehicle wreckage all become enemies. The drone becomes stronger against electronic warfare but more sensitive to the physical world. To go farther, it needs a longer line, and a longer line is heavier and more vulnerable. Technology covers one weakness while exposing another.

As of early 2026, analyses suggest that more than 35 companies in Ukraine are producing fiber-optic drones. On the Russian side as well, estimates suggest that

fiber-optic drones account for 30 to 50 percent of use in some front-line units. Both sides have moved quickly into this technology.

And the spread of this technology has changed the landscape of the battlefield. To stop drones that jamming cannot stop, soldiers began putting up physical nets again. When NPR reporter Eleanor Beardsley entered Izium in eastern Ukraine in March 2026, the entire road into the city was covered with white netting. The whole town was under a roof of anti-drone nets. "I couldn't believe it. We drove onto the main road, and it was completely covered with netting."

Ukraine's Defense Ministry announced that it would install anti-drone nets over about 4,000 kilometers of front-line roads by the end of 2026. According to Reuters, Minister Fedorov said, "We increased the pace from 5 kilometers a day in January to 12 kilometers in February." The March target was 20 kilometers a day. Business Insider also reported that in 2026 Ukraine had already installed nets over hundreds of kilometers of roads. It is a scene in which a defense structure of the digital age begins to resemble a fisherman's net.

Russia was learning the same lesson. In early 2025, video emerged of Russian forces installing a net tunnel over a two-kilometer stretch of road connecting Bakhmut and Chasiv Yar in the Donetsk region. Both sides are stopping drones that electronic warfare cannot stop with nets.

But Russian drone pilots found gaps in the nets. According to Business Insider, a tactic emerged in which fiber-optic drones are landed beside a road and left waiting, then take off at the moment an armored vehicle passes and attack from below the net in an ambush. It resembles the improvised explosive device, or IED, ambushes the U.S. military faced in the Middle East. One officer in Ukraine's 3rd Army Corps said such attacks occur every week, causing losses of both soldiers and vehicles.

Fiber-optic drones are strong against jamming. Wireless drones survive by changing frequencies. AI-assisted drones attempt autonomous flight by relying on computation and training data. But fiber optics catch on obstacles, wireless systems are caught by jamming, and AI is shaken by misrecognition. There is no complete solution. War always takes a technology that says, "This has solved it," and a few days later finds its

gap.

7-4 Pantsir Air Defense Systems Versus Drones, The SBU Alpha Unit's Results and the Neutralization of Half of Russia's Operational Inventory

The Pantsir air defense system was originally built to prevent exactly this kind of situation. It is a truck-mounted mobile system carrying two 30mm autocannons and twelve surface-to-air missiles, used to shoot down low-flying cruise missiles, drones, and helicopters. It is deployed around bases, radars, command posts, and long-range air defense systems as a shield. Each unit costs 15 million to 20 million dollars, roughly 20 billion to 28 billion won.

But in the Ukraine war, the shield became a target.

On February 14, 2026, the Security Service of Ukraine, or SBU, made an announcement. Its Alpha Special Operations Center had destroyed about half of Russia's operational Pantsir air defense systems through long-range strikes during 2025. Several outlets, including Ukrinform, the Kyiv Independent, RBC Ukraine, and Euromaidan Press, reported the announcement.

A closer look at the figures shows this. SBU chief Vasyl Maliuk said in late October 2025, "From the beginning of this year to today, we have destroyed 48 percent of their Pantsirs." According to SOFREP's analysis, Russia had 116 Pantsir systems just before the full-scale invasion in January 2022, then increased the number to more than 230 by producing about 30 per year. But the Alpha unit's strikes exceeded the pace of production. The SBU estimated the total value of Russian air defense assets destroyed by the Alpha unit in 2025 at about 4 billion dollars, or 5.6 trillion won. The independent open-source tracking group Oryx counted more than 38 visually confirmed Pantsir losses.

These numbers cannot be viewed apart from the fact that they are Ukrainian claims. Wartime announcements can be exaggerated, and some parts cannot be independently verified. Even so, the trend is clear: air defense systems are no longer safe rear-area equipment. They have become prey for drones.

Destroying a Pantsir is not merely breaking one piece of equipment. It opens a passage. In the SBU's words, "The systematic destruction of Pantsirs has a strategic goal: to pierce the enemy's air defense network and create corridors through which targets deep in the rear can be struck." When one piece of the air defense network disappears, the ammunition depots, airfields, and fuel facilities behind it are exposed. The reason drones could reach air bases in Siberia 4,300 kilometers away during Operation Spiderweb, see Chapter 1, was that this work of securing air defense corridors had already been done.

The Nemesis regiment is also one axis of this trend. In the Kyiv Independent interview, the regiment commander said, "Our regiment is one of the most successful in destroying the enemy's air defense systems." "According to our calculations this year, our regiment has destroyed more than 1 billion dollars' worth of enemy air defense assets." According to his explanation, enemy air defense must be removed first to secure freedom for aerial reconnaissance, and only then can enemy artillery, howitzers, and drone launch sites be found and struck.

Russia is not standing still. It moves the locations of air defense systems, puts up camouflage nets, sets up decoys, and places electronic warfare equipment nearby. Ukraine tries to reconnoiter from farther away, approach lower, and move with smaller signals. It looks like the classic contest of shield and spear, but in reality it is a contest of sensors and signals, camouflage and data. Before metal fights, eyes fight.

7-5 The Compute War, An Age in Which Processing Power Decides Victory or Defeat on the Battlefield

On the battlefield, computers are not on desks. They are inside the small boards of drones, inside laptops at artillery command posts, inside signal-processing chips in electronic warfare equipment, and inside graphics processing units, or GPUs, in video analysis servers. While bullets fly, pixels are being classified somewhere else, signals are being filtered, and trajectories are being predicted.

A passage in which the commander of the Nemesis regiment explains how his unit finds and destroys enemy drone operator teams shows this well. First, an analyst

reviews damage data, analyzes patterns in the enemy's use of unmanned equipment, and defines the search area. Aerial reconnaissance drones fly over the designated area and search. The collected data is passed to codebreakers and analysts. They calculate the radio horizon, the terrain-based limit of radio-wave reach, altitude, and possible launch points. Only then does the strike drone team sortie, but before that, they decide what ammunition to use, how to approach without being shot down, and what tactics to use.

This entire process rests on computing power. Collecting data, filtering it, analyzing it, and converting it into material for judgment. A human makes the final decision, but computers handle countless stages on the way to that decision.

At the edge of the battlefield, a few watts of power consumption, a few grams of weight, and a few milliseconds of latency decide life and death. Can a drone continue video-based target tracking when it loses the control signal in the final 500 meters? Can it combine inertial navigation with visual terrain matching when jamming begins? When a human cannot watch video from hundreds of drones at once, which screen should be brought up first? All of these questions are questions of computing power.

AI chip technology for small drones points in the same direction. The GAP9Shield study for nanodrones, published on arXiv in 2024, showed that a low-power module at the 150 GOPS level, 150 billion operations per second, could perform object detection, localization, and mapping. This does not mean battlefield equipment is the same as that research product. But the direction is clear. Drones must see more, judge faster, and perform more calculations with less power.

Ukraine's SmartPilot "mothership drone" is a combat example of this direction. According to a March 2026 analysis by drone-warfare.com, this drone uses visual-inertial navigation based on cameras and LiDAR, laser sensors, to carry two AI-guided FPV drones up to 300 kilometers. Without GPS or direct pilot input, AI independently selects targets.

Computing power connects to industrial capacity in the rear. Who can make more sensors? Who can store and train on more video? Who can mass-produce cheaper, tougher boards? Who can turn front-line feedback into code overnight and put it into

next week's product? If past wars were fights over steel and oil, this war is a fight over batteries, cameras, chips, and data. Bullets still kill people. But more and more calculation is entering the work of deciding where those bullets should go.

7-6 The Digital Spiderweb Left on the Front Line by Miles of Fiber-Optic Wire

After a battle, shell casings are not the only things left in the fields. Broken propellers, melted batteries, warhead fragments, cut cables, and long unwound fiber-optic wire remain. It is almost invisible. It glints only when the sunlight lies low. It wraps around a soldier's ankle as he walks, tangles in vehicle wheels, and sinks into the grass.

Fiber-optic wire is both a communications line and a trace. It tells where a drone started, which direction it went, and where it died. In skies ruled by electronic warfare, humans laid down lines again. Once the freedom of wireless was lost, they returned to the certainty of wired connection. But those lines are not buried underground like trench telephone lines. They unwind into the air behind drones and scatter across the fields.

The scene NPR's reporter saw in Izium is another side of this picture. White netting covering an entire city. Nets hung on poles placed at regular intervals along the road form a tunnel, and vehicles drive inside it. The reporter relayed the words of one soldier: "This is a sad landscape." A town with nets hanging over it is a new terrain created by war.

This scene compresses the character of the Ukraine war. Cutting-edge war is not sleek. It is often rough. AI finds targets, electronic warfare equipment pushes away signals, pilots endure video dropouts, and engineers solder new boards. Beside them, soldiers put nets over roads and walk around fiber-optic lines. Future war did not come only from glass-walled laboratories. It came carrying mud, solder, batteries, antennas, nets, and cables together.

The invisible war is more dangerous because it is invisible. Before the sound of an explosion is heard, the route twists; before the enemy is seen, the screen breaks; before an order comes down, the signal dies. Victory and defeat on the battlefield do

not depend only on who can make the bigger explosion. Who blurs the enemy's eyes first? Who can move even after the signal disappears? Who can turn the chaos of the front line into data, and data back into a weapon?

Miles of fiber optics remain across the fields. From far away, it is empty ground. Up close, that ground is already covered with the nervous system of machines. War begins first in what is unseen, not in what is seen.

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Chapter 8 The Economics of Asymmetry — Drones Upend the Defense Industry

8-1 FPV Drones at \$300-\$500, Pantsir at \$15 Million-\$20 Million — Cost Asymmetry Changes Strategy

The battlefield calculator is cold. Press a button, and blood-stained numbers climb.

A \$300 FPV drone crawls low over a trench. Its motor sounds light, like a toy, and its camera lens shakes like a cheap part. But the moment the explosive hanging from its end heads toward the radar of a \$15 million Pantsir air defense system, the ledger of war flips.

Prices for the Pantsir-S family of air defense systems vary across public sources. Ukrainian and military specialist outlets generally place them in the \$15 million-\$20 million range. In April 2026, a Pantsir-S that Ukraine's National Guard said it had destroyed was estimated at about \$15 million, and in another case, reports said an SBU drone had struck a \$20 million system.

The issue is not the absolute price. It is the exchange ratio.

Even if Ukraine loses several \$300-\$500 drones, if one of them blinds the eyes of an expensive air defense system, the battlefield income statement tilts toward Ukraine. The more Russia builds costly air defense networks, the more Ukraine sends cheap drones. At that moment, the old grammar of the defense industry began to shake.

Cold War defense worshiped sophistication. Thick armor, long range, high-powered radar, complex platforms developed over decades. The model spent billions of dollars to build a single system, and that one system dominated the battlefield. The war in Ukraine wrote a different sentence. Build cheaply, build many, fix often, deploy fast.

Operation Spiderweb was the case that showed this grammar most dramatically. According to Wang Jian's analysis, the FPV drones used in Operation Spiderweb cost about \$500-\$1,000 each, and even with 150 drones and 300 bombs combined, the

total cost did not exceed \$200,000. Even after adding planning, intelligence gathering, smuggling, and the construction of remote-control infrastructure, the total remained below \$5 million. With that money, Ukraine burned roughly \$7 billion in Russian strategic assets.

1 to 1,400. That is the return on investment of Operation Spiderweb. A venture capitalist would sign after seeing that number, but the assets in this ledger are tied to human lives. The logic of money is cold, and war runs on that coldness.

The record of the Nemesis Regiment was the result of repeating this asymmetry in a systematic way. In an in-depth interview with the Kyiv Independent, a drone commander said that, as of 2026, his unit had destroyed more than \$1 billion in enemy air defense assets. The SBU Alpha unit is estimated to have neutralized about half of Russia's operational Pantsir inventory between 2025 and early 2026. This is a record of objects worth a few hundred dollars repeatedly, systematically, and at industrial scale destroying objects worth tens of millions.

The economics of asymmetry was a method of war invented by the poorer side. Now that method is shaking the ground beneath the entire defense industry.

8-2 From Railway Chief to Architect of the Drone Program — Oleksandr Kamyshin's War of Numbers

Oleksandr Kamyshin was originally a railway man.

In February 2022, when Russia's invasion began, he was CEO of Ukrainian Railways, Ukrzaliznytsia. Millions of refugees had to get out to the west, and the trains had to keep running even as missiles struck railway stations. Kamyshin did it. Trains had to move on time for refugees to escape, ammunition to enter, and the state to keep from collapsing. President Zelensky saw that instinct and called him. He asked Kamyshin to become the chief architect of the drone program.

In an interview with CBS's 60 Minutes, Kamyshin summed up his principle in three words. "Cheap, fast, efficient." He said he had helped raise Ukraine's drone production from 2,000 units a year to 4 million.

From 2,000 to 4 million. It is worth pausing over what this number means. It is a 2,000-fold increase. It happened in a little over three years.

The war Kamyshin faced was closer to a timetable than a heroic tale. How many units can be made in a month? Which component is the bottleneck? How large is the gap between what the state can buy and what private companies can produce?

The "ZBROYARI: Manufacturing Freedom" initiative he presented in 2024, when he was minister of strategic industries, began in exactly that gap. The concern was that Ukraine's defense production capacity had reached about \$20 billion, while the government could actually purchase only about \$6 billion. A country with production capacity but not enough money. A country where the battlefield swallows drones faster than the budget can follow.

Kamyshin's approach was that of a railway operator. He counted everything. In the 60 Minutes interview, he said this: "This is a data-driven war. We speak numbers. It's a numbers game." The interviewer asked, "What do you mean by a numbers game?" Kamyshin answered, "We have to count everything. The number of drones we use, the efficiency of each one, even the cost to kill one Russian soldier."

"What's that cost?"

"You'll be surprised, but right now the cost to kill one Russian soldier is less than \$1,000."

This number is uncomfortable. It converts a human life into dollars. But Kamyshin ran the war inside that discomfort. If a country short of money is to fight a country with three times its population, it has to measure the efficiency of every input and decide the next order based on that measurement. Not emotion, but spreadsheets hold the front line.

In March 2025, after moving into a role as presidential adviser, Kamyshin went a step further in an interview with Radio Khartia. "Right now one FPV drone manufacturer can make 4,000 units a day. There are more than 150 such companies. Our annual FPV production capacity is over 5 million units." The problem was not production capacity. It was the money to buy it.

That is why Kamyshin began talking about exports. A self-sustaining cycle in which Ukraine sends drones to the front while also selling abroad to raise the money needed to keep factories running. War creates industry, industry feeds war, and exports grow the industry in a triangular rotation. Kamyshin was designing that rotation like a railway timetable.

8-3 95% Domestic Production, Drone Companies from 41 to 183 — The Explosion of a Wartime Industrial Ecosystem

Before the war, Ukraine's drone industry was thin.

In February 2022, only a few thousand unmanned systems were being made inside Ukraine. Civilian volunteers often bought DJI drones and sent them to the front, and many finished products depended on outside supply chains, including China. But the war created a market. No, it created something harsher than a market. A battlefield laboratory where equipment breaks every day and orders come in every day.

Poland's Centre for Eastern Studies, OSW, tracked the change in the number of new Ukrainian drone-related companies. 41 in 2022. 132 in 2023. 183 in 2024. In the first four months of 2025 alone, another 107 were registered. This ecosystem did not grow only behind the gray walls of arms factories. Garages, small workshops, offices with 3D printers, and Telegram messages from pilots returning from the front all became part of one production line.

The company Airlogix, covered by 60 Minutes, shows the face of this ecosystem. The company makes aerial surveillance drones for the Ukrainian military. Because its production facilities had already been destroyed twice by Russian bombing, it produces across more than 20 distributed sites. It is a dangerous business, but it attracted more than \$1 million from an American investment fund. The fund was run by two former U.S. Marines. William McNulty and Len Krawiec. "What's your primary motivation?" the interviewer asked. "Service, patriotism, democracy, mission. Ukraine satisfies all of that."

The domestic production ratio also rose quickly. This figure must be read carefully because public sources give different ranges. In September 2025, President Zelensky

said that nearly 60% of the weapons used by the Ukrainian military were domestically made. There were also reports that 95% of long-range drones were Ukrainian-made. In an interview with ChinaTalk, one Ukrainian industry figure said that, as of 2026, the final assembly rate for finished FPV drones had reached 99%.

This does not mean every component is produced domestically. Dependence on Chinese fiber optics, Chinese motors, and Chinese electronic parts remains. According to Ukrainian customs statistics, in the first quarter of 2025 alone, 127,800 civilian drones were imported, 98% of them from China. The import value reached \$371.3 million. Ukraine had changed into a country that buys parts but assembles and improves finished products itself. It had not achieved supply-chain independence.

But the direction of change was clear. In the past, the state set performance requirements, major defense contractors developed products over several years, and deliveries came after testing and evaluation. Ukraine's drone industry moved in the opposite direction. The front line demands, a small company builds, a soldier tries it, and a new version appears a week later. The case of Tech Core, the company founded by former brewery engineer Roman Tkachinsky to make armored drones for evacuating wounded soldiers, compresses this pattern. "How do you know what the next design needs?" the 60 Minutes interviewer asked. "We cooperate with the end users. The end users are the soldiers on the front line." "The soldiers said they needed an evacuation drone, and you built it." "Yes. That's how it works in Ukraine."

The production trajectory shows how quickly this ecosystem grew. About 800,000 units in 2023. About 2.2 million in 2024. More than 4 million in 2025. The target for 2026 is 7 million. Compared with Bloomberg's estimate that the United States makes about 100,000 military drones a year, Ukraine has set a plan to make 70 times as many as the United States. It is a number born from the urgency of wartime.

The financial performance of the drone industry followed. According to OSW's analysis, the drone industry, which recorded a net loss of more than 2 billion hryvnias, about \$46 million, in 2022, achieved net profit of 4.6 billion hryvnias, about \$107 million, and revenue of 44 billion hryvnias, about \$1 billion, in 2023. In 2024, revenue jumped to 100 billion hryvnias, about \$2.3 billion, and net profit exceeded 13.8 billion hryvnias, about

\$303 million.

War gives birth to industry, industry earns profit, and profit goes back into war. This cycle was the engine of Ukraine's drone ecosystem. A market where Telegram videos become proof before delivery paperwork, and surviving equipment calls forth the next order. It was a market running at a speed entirely different from the bureaucratic development cycles of Cold War defense.

8-4 Drone Deals — European Arms Export Offices, 10-Year Contracts with Saudi Arabia, the UAE, and Qatar

Ukrainian drones were originally hard to sell abroad.

Every drone a country at war could make had to go to the front. After the full-scale invasion in 2022, Ukraine banned arms exports. The front line always reached out first, and even if foreign customers wanted to buy, Ukraine could not sell. The Washington Post reported in 2025 that about 500 drone manufacturers wanted to export, but actual sales were limited by wartime demand and administrative procedures.

But as the war dragged on, the calculation changed. Production capacity began to outpace government purchasing power. According to a Georgetown University security studies analysis, Tech Force in Ukraine, an association of Ukrainian defense technology manufacturers, said that in 2024 drone and electronic warfare companies were operating at only 37% of capacity because of a lack of government contracts. Factories could run more, but there was no buyer.

Exports therefore became not commerce, but a survival strategy. A self-sustaining cycle in which money earned abroad keeps production lines running, and a large share of the drones from those lines goes to the front. In April 2026, President Zelensky officially announced "controlled export." According to Euronews, he said, "In some types of weapons, production surplus reaches 50%, and this is a direct result of state investment in our defense industry and cooperation with our partners."

There was a condition. Ukraine would sell only to countries that had supported it since the full-scale invasion of 2022.

The movement was fast. According to the Kyiv Independent, Ukraine decided to open its first defense export representative offices in Berlin and Copenhagen at the end of 2025. Kamyshin and Defense Minister Umerov announced it themselves. Reuters reported in March 2026 that Ukraine was pursuing joint drone production with Germany, Britain, Denmark, and the Netherlands, and that Norway was expected to join.

The Middle East also knocked on the door. The Ukrainian outlet New Voice of Ukraine reported in April 2026 on so-called "Drone Deals" with Saudi Arabia, Qatar, and the UAE. According to Reuters, Ukraine signed a defense cooperation agreement with Saudi Arabia, concluded a 10-year cooperation agreement with Qatar, and pursued a similar agreement with the UAE. These included joint drone production, counter-drone systems, and air defense-related technical cooperation.

Weapons proven on the battlefield gain a market without passing through a showroom. Ukraine's drone industry entered exactly that path. Combat footage circulates before product brochures, and shootdown statistics call customers before trade-fair booths do.

The language of defense exports had changed.

8-5 The Call Asking Ukraine to Stop Iranian Shaheds — The Gulf's Appeal for Ukrainian Interceptor Drones

The reason Gulf states looked to Ukraine was plain. They were watching Shaheds too.

The Iranian-made Shahed loitering munition is cheap, flies in large numbers, and quickly empties the ammunition stores of expensive missile defense systems. Ukraine spent years dealing with the Shahed-family drones Russia launched. At first, Ukraine shot them down with expensive missiles. But to keep using air defense systems firing missiles worth millions of dollars each against Shaheds worth tens of thousands is a mathematically losing game. Once stocks of air defense missiles run down, it becomes impossible to stop the real threats: cruise missiles and ballistic missiles.

So Ukraine reversed the idea. Use drones to stop drones. The Sting interceptor drone tracks a Shahed in the air and destroys it by collision. Reports said each unit cost about \$2,000-\$6,000. If Ukraine uses interceptor drones worth a few thousand dollars instead of missiles worth millions, it can save expensive missiles for more dangerous targets.

After hearing this, the oil-producing states of the Middle East began making calls.

Reuters reported in March 2026 that Ukraine had sent 228 drone interception specialists to five countries, including the UAE, Saudi Arabia, Qatar, Kuwait, and Jordan. They provided air defense advice and interception support in response to Iranian drone attacks. In a follow-up Reuters report in April 2026, Gulf states including Saudi Arabia and the UAE were said to be examining Ukrainian-designed interceptor drones costing around \$2,500.

President Zelensky raised this context directly in a March 2026 speech to the British Parliament. According to Business Insider, he said in effect that Ukraine could make 2,000 effective interceptor drones a day, use half for domestic defense, and supply the other half to allies.

Ukraine needed money, and the Gulf needed experience. One side lacked the funds to run its factories harder, and the other was tired of using expensive missiles to stop cheap drones. So the calls came. "Stop the Shaheds for us."

That call was a request to buy weapons, and also a question about the direction of the 21st-century defense industry. Will countries keep firing expensive missiles without end, or will they grow cheap, numerous means of interception? Ukraine had tested the latter answer on the battlefield, and the global arms market began asking for its price tag.

8-6 Russia's Response — Military Spending at 7.5% of GDP, the Creation of the Unmanned Systems Forces, and the Gap That Does Not Close

Russia did not stand still.

In a report released in April 2026, SIPRI, the Stockholm International Peace Research Institute, estimated Russia's total military spending in 2025 at \$190 billion, 7.5% of GDP. That was three times the global average military spending ratio of 2.5%, and it meant Russia was the world's third-largest military spender after the United States and China. SIPRI researcher Lorenzo Scarazzato said that "in 2025, military spending as a share of government expenditure in both Russia and Ukraine reached record highs."

In its 2026 budget proposal, Russia slightly reduced defense spending to 14.9 trillion rubles, 6.3% of GDP. It was the first nominal decrease in military spending since the full-scale invasion, and SIPRI's analysis saw it as a sign of fiscal pressure. With tight monetary policy to restrain inflation, the fiscal deficit reached 2.6% of GDP at the end of 2025, and the Russian government had to raise VAT to 22% and corporate tax to 25% to fund the war.

But pouring in money and getting results from that money are different matters.

In November 2025, Russia created the Unmanned Systems Forces, VBS, as a new branch of the military. According to Wikipedia, about 114,000 personnel were assigned as of May 2026. In April 2026, Ukraine's commander-in-chief Syrskyi said Russia was trying to expand its unmanned systems personnel to 165,000 by the end of the year. The Jamestown Foundation analyzed this as a change that institutionalized lessons from the war in Ukraine. After Ukraine created its Unmanned Systems Forces in June 2024, Russia followed 17 months later and inserted drones into its military structure.

Russia's response is enormous. It can pour in budgets, create a service branch, and increase personnel.

But size is not agility.

Ukraine's drone ecosystem spins quickly in small spaces. Designers meet pilots, pilots send destruction footage, and companies change parts that night. The innovation cycle is one week. Russia's bureaucratic military procurement system struggles to match this speed. Western semiconductor sanctions are also holding Russia back. In the development of AI-based autonomous drone flight, electronic warfare bypass algorithms, and target recognition software, all of which require high-performance

chips, Russia faces difficulty procuring parts.

The gap does not arise only from the size of the money. It arises from the speed of learning.

The more Russia increases military spending, the more expensive the war becomes. The more Ukraine increases drones, the more finely the war is broken into pieces. The age of building one tank for a long time in one factory and the age of turning out thousands of small eyes and wings with weekly changes are colliding on the same battlefield.

The defense industry is no longer an industry of tanks and missiles alone. Hands soldering parts, developers fixing code, engineers modifying agricultural motors, and short Telegram messages from soldiers returning from the front have all become part of defense.

The economics of asymmetry was the invention of the poorer side. But now wealthy countries are lining up to learn it. War is a cruel school. Ukraine has paid the highest tuition in that school, and the global defense market is standing at the door, trying to buy its notes.

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Chapter 9 The War You Prepared For Will Never Happen Again

9-1 "You Will Not Be Able to Use a Fleet at All" — The Question Asked by a Soldier from One Country

The country he came from was not disclosed. Nor was his rank. In a meeting with a drone commander from Ukraine's Unmanned Systems Forces, the officer from a Western country was probably thinking of his own navy when he asked:

"How can a fleet be operated on the modern battlefield?"

The commander who received the question may have thought for a moment. Perhaps not. He already had the answer. He had seen with his own eyes what had happened in the Black Sea.

"You will not be able to use a fleet at all."

This answer was not an insult to navies. Nor was it a doubt cast on the courage of captains. It meant the arithmetic of the sea had changed. The moment a frigate worth hundreds of billions of won leaves port, the door of a container somewhere along the coastline opens. From inside, a maritime drone worth about \$300,000 is lowered onto the water. Radar catches it late, its speed is sufficient, and it carries enough explosives to tear through a warship's armor. If ten of them sortie at once instead of one, the warship's captain has only a few minutes left.

The commander drew this warning from experience. Ukraine had, in effect, no navy. Almost nothing remained that could be called its own fleet. Yet it pushed the Russian Black Sea Fleet, one of the most powerful navies in the world, back into port. It forced every warship to hide. As of 2026, Russian warships have disappeared from the Black Sea. This was the work of Sea Baby, a maritime drone developed by the Security Service of Ukraine (SBU), and its successor models. They repeatedly struck Russian naval assets and Black Sea infrastructure, and in 2026 Ukraine unveiled a next-generation maritime drone capable of operating beyond the Black Sea in more distant waters.

The commander's advice was this: if you insist on using a fleet, limit it to the role of coastal artillery or coastal air defense. Use it only to defend the coastline. If it goes out to sea, it will be quickly sunk by an enemy equipped with unmanned systems.

The shock of this conversation did not stop with the single officer who had asked the question. In an interview with the Kyiv Independent, the drone commander who recounted the exchange added calmly that he is sometimes surprised by the questions Western soldiers ask when they come to meet him. By the size of what they still do not know.

9-2 Combat Helicopters, Attack Aircraft, Tank Columns — The List of Weapons That Can No Longer Be Used

When that officer asked about fleets, the drone commander did not stop with the sea. There was more on the list.

"You will not be able to use aviation. I mean military aviation, helicopters. Nor will you be able to strike with attack aircraft. Tanks, armored vehicles, columns of units advancing together. Not the way you learned. All of that is the past."

The reason these words feel heavy is that this "past" is the "present" of almost every military in the world. Combat helicopters were designed to fly low and hunt enemy tanks. Attack aircraft were trained to strike targets behind the front line. Tank columns were built to break through under the cover of artillery and infantry. For decades, this was the skeleton of modern war. It was what military schools taught, what budget officials translated into numbers, and what defense companies moved onto production lines.

On the Ukrainian front, that skeleton broke. Turn on an engine and heat is detected. Drive along a road and a trail remains. Stop in one place and it becomes coordinates. On a battlefield where reconnaissance drones cover the sky, movement itself becomes a report. In its 2026 front-line reporting, Britain's The Sun reported that a drone kill zone 10 to 15 kilometers wide had formed. Inside it, the movement of troops and equipment was under constant surveillance and attack.

To say tanks have become useless is only half right. More precisely, the age in which a tank could survive alone has ended. The claim that helicopters have become useless is only half true as well. What collapsed was the doctrine that assumed helicopters could approach safely. It is not that attack aircraft cannot fly. The entire system, including runways, maintenance depots, fuel facilities, pilots, air defense networks, and electronic warfare conditions, has entered the net of drones and surveillance.

Weapons do not disappear. They simply can no longer be used as they once were. And that is more frightening. Expensive equipment remains in warehouses, while the way to use it on the battlefield has vanished. U.S. Army Captain Ronan Sefton was tasked in 2022 with providing basic training in Germany to more than 8,000 Ukrainian soldiers, and he admitted in a 60 Minutes interview that almost immediately, the Americans began learning from the Ukrainians. The first thing they realized was that "we needed more drones," and that they had to be everywhere on the training ground.

Captain Sefton now works on the Army Ukraine Lessons Learned Task Force. His job is to translate Ukraine's battlefield experience into the vast U.S. military system. His judgment was this: howitzers are still needed, and Abrams tanks are still needed, but the military has to figure out how to make drones work together with them. That challenge, he said, is at the heart of preparing for the next war.

9-3 "What Happens If There Is No GPS?" "There Will Be No GPS."

It happened at a training ground.

Western soldiers and defense engineers had brought something with confidence. Hundreds of GPS-based unmanned systems. They said the equipment had already completed development and entered mass production. They showed it to the Ukrainian commander and asked, "How do you think this can be used?"

The commander was not a technician. But he had experience. So he asked a few questions. "How is the connection secured? How does launch work?" After hearing the answers, he said:

"This will not work."

They pushed back. "We have GPS."

The commander said, "There will be no GPS."

"Why would there be no GPS? There are satellites, aren't there?"

"It will be jammed. There will be no GPS."

The conversation stopped there. They said they "did not know what happens next."

Time passed, and they came back. This time, they brought a GPS reinforcement device. "Now GPS will work. This device amplifies the signal." The commander looked at it and said, "We used this a year and a half ago. It does not work now."

"Damn it, we already bought hundreds of them."

What makes this conversation chilling is not cynicism about technology. It is that modern militaries have placed too much on a single invisible signal. Position, time, navigation, artillery correction, drone flight, vehicle movement, communications synchronization. GPS is not a convenience facility of war. It has become war's bloodstream. Russian and Ukrainian electronic warfare has learned how to press on that bloodstream. GPS jamming sends drones to the wrong place, spoofing deceives navigation, and even civilian areas are put at risk. In June 2026, Business Insider reported an incident in which a Ukrainian maritime drone, pushed off course by the effects of Russian electronic warfare, drifted toward the Romanian port of Constanta and exploded.

A battlefield without GPS does not mean a return to paper maps and compasses. Inertial navigation, terrain matching, image recognition, fiber-optic control, multi-sensor fusion, and machine-learning-based jamming detection all enter at once. The age of relying on one signal gives way to an age of survival through overlapping senses. Studies published on arXiv have dealt with machine-learning approaches for detecting GNSS/GPS jamming and spoofing, and methods have also been proposed for detecting falsification in unmanned aerial vehicle swarms by comparing GPS coordinates with ultra-wideband ranging.

The fact that systems built by Western militaries at a cost of hundreds of millions of dollars were, on the Ukrainian front, merely technology that had become obsolete a year and a half earlier. This is not a question of money. It is a question of speed. The battlefield is faster than the laboratory. War does not wait for procurement procedures.

9-4 The Day a Small Number of Drone Pilots Defeated a Large Force in a NATO Exercise

May 2025, Estonia. A NATO joint exercise named "Hedgehog 2025" was held. More than 16,000 soldiers from 12 allied countries took part. Britain's Challenger 2 tanks, Apache attack helicopters, and HIMARS rocket artillery were deployed. It was a list of equipment that could have appeared in a textbook on modern ground warfare.

One training scenario was prepared. A battle group of several thousand troops, including a British brigade and an Estonian division, would launch an attack. As in the manuals, armored units would lead, infantry would follow, and artillery would provide support.

When they began to advance, there were about 10 Ukrainian drone pilots on the opposite side. They were combat veterans who had briefly rotated out from the front.

It did not take half a day. According to the Wall Street Journal, this team of 10 Ukrainian pilots, playing the enemy role, virtually destroyed 17 armored vehicles and carried out about 30 strikes. One participant put it this way: "They took out two battalions in one day." The other side's reaction was more raw. A NATO soldier quoted by Euromaidan Press said, "We are f——."

What happened?

The NATO battle group was "just moving around," one participant recalled. They pitched tents without camouflage and parked armored vehicles side by side. They did not check for mines, and after dismounting they did not disperse. They had not factored in the reality that drones had made the battlefield transparent. Aivar Hanniotti, the Estonian officer responsible for unmanned systems, said more than 30 drones were flown over an area of less than four square miles. His assessment was that "there was nowhere to hide."

The Ukrainian team used a battlefield management system called Delta. It is a system that collects real-time information, has AI analyze it, identifies targets, and coordinates between command and strike units. Operated for the first time on Estonian soil, the system showed that the core of drone war is not the performance of a single piece of equipment, but the speed with which information and strikes are connected.

Pilots from the 412th Nemesis Brigade also took part in the exercise. According to *Ukrainska Pravda*, at first the Estonian commander did not know how to use these Ukrainian pilots. They were simply kept on standby, waiting for something to happen. The Ukrainian soldiers stepped forward first. They explained that "besides bombing, we can be used for reconnaissance, logistics, and strike planning," and began working with the Estonian reconnaissance drone team. When the Estonians found a target, the Ukrainians struck it.

After the exercise, Estonian security expert Ilmar Raag published an analysis. According to calculations by Ukrainian drone pilots, Estonia alone would need 200,000 drones per month in wartime. Ukraine increased its drone production from 2.2 million units in 2024 to 4.5 million in 2025, but no NATO ally has yet approached that industrial capacity.

What this exercise left behind was not a record of defeat. It was a record of the causes of defeat. Sixteen thousand soldiers saw with their own eyes what had been missing from the order of battle, which assumptions had been wrong, and which habits could cost lives. Retired U.S. General David Petraeus pointed out that the answer is not simply buying more drones, but rebuilding concepts, doctrine, training, organization, and procurement.

9-5 "Donald Trump May Think We Have No Cards to Play" — Battlefield Asymmetry Changes the Negotiating Table

February 2025, Washington. President Donald Trump told Zelensky that Ukraine had no cards to play in negotiations. In March 2026, *The Brussels Times* reported that Trump had said Zelensky had even fewer cards.

Three months later, on June 1, 2025, Operation Spiderweb was carried out.

Everyone could see that the timing was no accident. It was the day before peace talks with Russia were scheduled in Istanbul, Turkey. Ukraine did not use a single piece of American equipment. It hid 117 domestically manufactured FPV drones inside truck containers, smuggled them deep into mainland Russia, and simultaneously struck four air bases scattered across Siberia and the Arctic Circle. The United States was not notified in advance. According to the Kyiv Post, President Trump was at a golf course in Virginia while the operation was under way, and the Department of Defense learned of it only after the operation had ended.

Overnight, more than one-third of Russia's strategic bomber fleet was destroyed or damaged. Tu-95MS, Tu-22M3, and Tu-160 strategic bombers, along with an A-50 early-warning aircraft, burned on the runways. Ukraine claimed 41 aircraft destroyed, online analysts visually confirmed about 14, and two U.S. officials told Reuters that about 20 had been hit and 10 destroyed. The estimated damage was about \$7 billion. The cost of the operation appears to have been less than \$5 million.

The Christian Science Monitor analyzed that Zelensky's real target was not only Russia. It was the United States. The fact that Ukraine could inflict serious damage deep, truly deep, inside mainland Russia directly contradicted the assumption that it had "no cards."

Trump's reaction was complicated. According to the Washington Examiner, a week after the operation, Trump was asked by a reporter aboard Air Force One whether Zelensky now had more cards to play. He answered: "They gave Putin a reason to go in and bomb the hell out of them. I didn't like it. When I saw it, I said, here we go, now it's going to be a strike." Around the same time, however, Trump wrote on social media that Putin had gone "absolutely crazy" and warned that he was "playing with fire."

The Istanbul talks ended after a little more than an hour. They agreed only on a prisoner exchange. There was no progress toward a ceasefire.

Territory and troop numbers are not the only cards. The ability to make the other side's rear insecure, the ability to keep consuming expensive assets with cheap

equipment, and the ability to pull the global defense ecosystem into the speed of one's own war are cards as well. Faced with an exchange ratio in which a \$500 drone destroys a bomber worth tens of millions of dollars, the arithmetic of the negotiating table begins to read not equipment lists, but the slope of the exchange ratio. Operation Spiderweb showed that slope to the world.

Some of the destroyed aircraft were models Russia no longer produces. These aircraft were part of its strategic bomber fleet capable of carrying nuclear missiles. Russia's means of projecting nuclear deterrence had been reduced. Foreign Policy assessed that the operation directly refuted the myth of Russian invincibility. Russia had portrayed victory in this war as unavoidable, but the sight of its own bombers burning in the middle of Siberia tore that narrative apart.

And as of June 9, 2026, according to The Hill, the Trump administration is delaying a large-scale drone deal with Ukraine. In a CBS interview, Zelensky said, "This cooperation can be the strongest in the world," while also saying that "we have not yet signed a big document." Countries in the Middle East and Africa showed interest first, but Ukraine gave priority to Washington, he said. It seems that another kind of time is needed before a card proved on the battlefield is accepted at the negotiating table.

9-6 German-Ukrainian Drone Cooperation, EU Drone Industrial Independence — The Reshaping of Europe's Security Landscape

April 14, 2026, Berlin. President Zelensky visited Germany leading a government delegation. Chancellor Friedrich Merz received him. In the exhibition hall where the two stood side by side, jointly produced German-Ukrainian drones were on display. Merz personally inspected the Strila drone.

At this event, the two countries signed a declaration of strategic partnership. According to German federal government documents, the declaration specified air defense, missiles, support for the drone industry, joint production, data cooperation, and joint research and development. It also included direct support for Ukraine's drone industry and the establishment of a joint venture for drone co-production. According to Germany's Ministry of Defense, the first stage of cooperation in the drone field in 2026

is scheduled to produce thousands of units, and cooperation between QuantumSystems and Frontline Robotics, as well as a plan to deliver 10,000 Linza unmanned aerial vehicles, is also under way.

On the same day, a joint venture between Germany's Auterion and Ukraine's Airlogix signed its first production contract. According to Tech.eu, the contract moved an announcement made at the Munich Security Conference in February 2026 into actual production, with German production lines set to build thousands of mid-range, large AI-guided autonomous strike systems per year. It was the largest production order for large autonomous strike drones in German history.

At a press conference, Chancellor Merz said: "This partnership is not only for Ukraine's defense. It is also for our security. Because in recent decades, no army in Europe has had as much combat experience as Ukraine." Zelensky said he had "proposed a drone agreement, a bilateral drone deal, to Germany," adding that it included "various types of drones, missiles, software, and modern defense systems." Ukraine's Defense Minister Fedorov described the €4 billion support package Germany had agreed to provide as "a massive increase in air defense capability."

This current is not the language of aid. It is the language of production. Ukraine is not merely asking for weapons. It is saying: let us build them together. German companies, Estonian test grounds, and Ukrainian battlefield data are being placed on a single circuit board. An April 2026 analysis by OSW, Poland's Centre for Eastern Studies, noted the Auterion-Airlogix joint venture, cooperation between Helsing and Ukraine's Terminal Autonomy, and the trend of producing Ukrainian-designed drones inside Germany. This is not the relocation of factories. It is the relocation of war feedback. Technology renewed on a weekly cycle at the front flows into German production lines.

Three weeks later, on May 5, 2026, the European Commission went one step further. It announced that it was recruiting founding members for the EU-Ukraine Drone Alliance. Companies with experience in the drone and counter-drone ecosystems of the EU and Ukraine would form the founding board and decide the alliance's priorities and direction of activity. According to the Kyiv Independent, the Commission said that "repeated violations of EU member states' airspace show the urgency of building

flexible and agile European capabilities to respond to unmanned aerial vehicles." It aims to begin operations by the end of 2026 and to develop joint ventures, technology roadmaps, and interoperability standards by 2027.

After the Cold War, Europe slept for a long time under America's strategic umbrella. The umbrella was comfortable. When it rained, you opened it. There was a time when the United States was Europe's absolute security guarantor. European countries did not realize that this time was ending only because of Russia's invasion. Political changes inside the United States, wavering aid promises, and signals arriving from across the Atlantic overlapped.

In the age of drones, rain does not fall only from above. War seeps in through warehouse doors, the surface of harbors, dirt roads in forests, civilian communications networks, and commercial component supply chains. An umbrella covers only the head. It cannot stop water entering at the ankles.

In his interview with the Kyiv Independent, the drone commander gave European countries this advice. Start small. Begin by thoroughly studying the experience of the Russia-Ukraine war. And "do not pour absolutely all your money into armored vehicles, artillery, and traditional means of warfare." He also warned that old large weapons manufacturers would lobby them to buy old weapons. The first task, he said, was to create their own unmanned systems forces and build independent capabilities.

It is true that Europe opened that ledger late. But once it opened it, it began drawing lines in haste.

An army that prepares for the wars of the past is bewildered on the first day of the next war. A larger fleet, thicker armor, and more expensive fighter jets are not the answer. What is needed is a hand that can change parts quickly. A factory that can fix failed equipment again that very night. A system that reflects footage sent by a soldier at the front in the following week's production line. A sense of direction that can find the way even in a sky where GPS has disappeared.

The war a country prepares for does not return. What returns is only the name: war.

Ukraine's drone war has shown that fact at high cost, and with clarity.

Chapter 10 Drones on the Korean Peninsula: What This War Is Telling Us

On December 26, 2022, the sky over Seoul was gray.

The subway was packed with commuters, traffic backed up on every bridge over the Han River, and Christmas decorations still hung in the windows of riverside apartments. Then small dots appeared on military radar screens. Slow, low, irregular movements. A flock of birds? No. Five North Korean unmanned aerial vehicles were crossing the Military Demarcation Line.

Fighter jets took off. KA-1 light attack aircraft were scrambled. Attack helicopters followed. Machine guns were fired. At one point, civilian flights were briefly halted. One of the drones reached the airspace over northern Seoul, and the incident spread into controversy over whether it had entered the no-fly zone near the presidential office. The chase lasted nearly five hours, and roughly 100 rounds were fired. The result: zero drones shot down. During the response, one KA-1 crashed.

It was the day a huge military failed to catch a small dot.

That scene should not be left as a humiliating episode. It was a notice that the grammar of war on the Korean Peninsula was changing. The North Korean drones were not advanced stealth bombers. They were slow, small, and probably not expensive. The heart of the threat was not their performance. It was that, because they were slow, cheap, and small, they slipped between the eyes and hands of the existing air-defense network. War sometimes arrives this way. It strikes old ways of thinking before it strikes with high-performance weapons.

10-1 North Korean Drones Over Seoul in December 2022: The Day Not One Was Shot Down

For a long time, the South Korean military has prepared by looking at North Korea's long-range artillery, special forces, ballistic missiles, and nuclear weapons. These were real threats. In tunnels north of the armistice line, on mobile launchers, at

multiple-rocket-launcher sites, and in submarine bases, visible danger existed. South Korea's military preparations were therefore largely aimed at things that were big, fast, and powerful. Faster fighter jets, more precise missiles, thicker defensive shields. What passed through the sky over Seoul in December 2022 was the opposite.

The drones were small. Slow. Their radar cross section (RCS) was so tiny that even multibillion-dollar advanced radar and air-defense systems struggled to detect them. Fighter jets were too fast. Helicopters could approach, but firing over a city meant the immediate risk of civilian harm. Sending fighter jets and helicopters to catch one drone was a military response, but economically it was an inverted bill.

The battlefield in Ukraine is rewriting that bill every day. FPV drones worth a few hundred dollars stop tanks worth millions. Unmanned aircraft worth a few thousand dollars find and destroy Pantsir air-defense systems worth \$15 million to \$20 million. Expensive weapons do not simply defeat cheap weapons; cheap weapons keep forcing expensive systems to appear. According to the commander of the Nemesis Regiment in an interview with the Kyiv Independent, that regiment alone has destroyed more than \$1 billion in Russian air-defense assets since the start of 2026.

The question is the same on the Korean Peninsula. When one North Korean drone enters the sky over Seoul, how much can we spend on a response, and within how many minutes? And can we repeat that response ten times a day, a hundred times, a thousand times?

10-2 The Contradiction of Calling for 500,000 Drone Warriors While Dismantling the Drone Command

In September 2025, then Minister of National Defense Ahn Gyu-back announced the idea of "500,000 drone warriors." The plan was to give every conscripted soldier an opportunity to train on unmanned aerial systems (UAS) during mandatory service. The Army's 36th Infantry Division in Wonju was designated as the first pilot unit, and reports said roughly 33 billion won had been allocated in the 2026 budget to secure about 11,000 commercial training drones. According to the Korea Herald, the Ministry of National Defense explained that the program would "not only raise the military's

drone operational capability but also create a foundation for soldiers to work in related industries after discharge."

The direction itself is hard to reject. After the war in Ukraine, planting a drone instinct across the whole military became an unavoidable choice. Yet around the same time, different news emerged.

In January 2026, a public-private-military special advisory committee under the Ministry of National Defense recommended abolishing the Drone Operations Command. According to the Seoul Shinmun, the command was expected to be dissolved as a Joint Operations Command was created. Then the wind shifted. On March 19, 2026, the Ministry of National Defense announced that it would not abolish the Drone Operations Command but would reorganize its role. Operational functions would be dispersed among the services, while the unit would be reshaped around drone policy, education, and civilian cooperation.

There are understandable reasons. The Drone Operations Command became deeply entangled in political controversy. Allegations of a drone infiltration into Pyongyang in 2024 overlapped with the emergency martial-law crisis, and the organization could no longer remain a pure symbol of military innovation. It had been caught in the net of politics. But war does not wait for political wounds to heal.

The problem is not the nameplate. More important than whether the command is kept or reorganized is who takes responsibility for drone forces, who experiments, who records failures, and who fixes them in a new way a week later.

An analysis published in War on the Rocks in June 2026 sharply identified this problem. Written by a former South Korean military surface-to-air missile operator and co-founder of a counter-drone red team, the piece pointed out the structural contradiction in the 500,000 drone warriors plan. The South Korean military currently has only about 1,100 small training drones, and since almost 90 percent of commercial drones are foreign-made, mostly Chinese-made, there is not enough supply that meets requirements for Korean-made parts. Hanwha and LIG Nex1 are running loitering munition programs, but those are combat weapon systems, not training drones to be handed to conscripts.

The lesson of the Ukrainian battlefield does not end with the phrase "create drone units." The crueler lesson lies elsewhere. If an organization cannot keep up with the speed of technology, soldiers enter a new battlefield carrying old manuals. It is like entering a metaverse conference room with a paper map. Compared with Ukraine, which created the Unmanned Systems Forces (SBS) in 2024 and gave them independent command authority and a budget, producing frontline feedback innovation on a weekly cycle, the gap between slogans and execution becomes visible.

10-3 A 248-Kilometer Armistice Line, Dense Metropolitan Areas, LNG Facilities: A Narrower and Denser Battlefield Than Ukraine

The battlefield on the Korean Peninsula is narrower than Ukraine's. The danger is not smaller. It is denser.

Ukraine's territory is roughly three times the size of the entire Korean Peninsula. Its front line stretches across a vast land of more than 1,000 kilometers. By contrast, the total length of the Military Demarcation Line (MDL) on the Korean Peninsula is only 248 kilometers, or 155 miles. Across this narrow line, some of the world's largest military forces face one another in extreme concentration.

Distance is the problem. From the armistice line to northern Seoul is only 40 to 50 kilometers. Within this shallow depth lie half of South Korea's population and most of the country's GDP. Airports, ports, power plants, substations, data centers, communications networks, logistics hubs, LNG storage facilities, and petrochemical complexes are tangled across the Seoul metropolitan area and along the coast.

In Ukraine, drones in Operation Spiderweb had to fly thousands of kilometers to strike strategic bomber bases inside mainland Russia. The operation took 18 months to prepare, and drones had to be hidden in trucks and smuggled in. On the Korean Peninsula, no such complicated route is needed. Launch a small drone worth a few hundred dollars, or a modified civilian unmanned aircraft, from near the armistice line, and it reaches northern Seoul in minutes. Even without exploding, society pauses. A drone hovering over a substation, an unidentified flying object near port cranes, a small unmanned aircraft appearing on the approach path to an airport runway, a

reconnaissance drone filming the outer perimeter of an LNG facility. Small wings disturb the heartbeat of a city.

The commander of Ukraine's Nemesis Regiment said this in an interview with the Kyiv Independent: "Today we understand that every movement of the enemy, every combat operation, is monitored by drones. And drones enter battle first." The reality of the front, where every vehicle within five kilometers of the line is effectively facing death, must be read together with the fact that on the Korean Peninsula the distance between the front and the capital region is only a few times that.

When war breaks out, it is easy to imagine tanks rolling south first. The fear of the actual first day may come from smaller things, in many more places.

10-4 Can a Conscription Army Raise "Gamers in Hoodies"?

The central figures of Ukraine's Unmanned Systems Forces (SBS) are far from the traditional image of soldiers. The commander of the Nemesis Regiment, interviewed by the Kyiv Independent, described them this way: "A gamer in a hoodie and a person who vapes, that's probably 70 percent of the Armed Forces of Ukraine. We have more, about 90 percent." People wearing hoodies over uniforms, holding joysticks in their hands, getting information about new antennas from Telegram channels. Their rank may be low, but their battlefield instincts are fast.

Ukraine accepted the technical instinct and creativity of such people into the military organization as they were. A recruitment announcement for 15,000 people explicitly named electronics engineers, programmers, 3D designers, and project managers. In a recruitment video, SBS commander Madiar said, "The drones are waiting for pilots, not the other way around." According to 60 Minutes, the innovation cycle is about one week. One week was enough to send drones to the front, receive feedback, change something, and release a new version.

The South Korean military is a conscription army. This is both a weakness and an asset.

The weakness is that service is short, and skill is hard to accumulate. With mandatory service of 18 months, based on the Army standard, it is difficult to train elite drone

specialists capable of mastering advancing electronic-warfare bypass techniques or Autonomous-flight coding. The asset is that the technical instincts of younger generations enter the military every year. Young people who are good at games, handle video equipment, and have tried coding are already inside the barracks. The question is whether the military has the eye to recognize them as military assets.

Drone piloting is different from bayonet training. It requires reading the movement of pixels on a screen, sensing the moment a signal is about to break, and calculating battery, wind, and terrain at the same time. Fail, and the aircraft falls. Do it well, and one piece of enemy equipment disappears. This ability does not emerge from shouting slogans loudly on a training field. It requires repetition, competition, experimentation, and feedback.

"500,000 drone warriors" must not end as a numerical slogan. Showing 500,000 people a video on how to pilot a drone is entirely different from training 50,000 skilled pilots, 5,000 maintenance and modification personnel, and 500 tactical designers. Drone warfare needs a pyramid. Selection, skill-building, specialization, and reserve-force links after discharge must be built on top of broad basic education.

A soldier who is good at piloting should fly longer. A soldier who fixes breakdowns well should go to a maintenance cell. A soldier who produces strange ideas should be sent to a lab before being scolded. If the military fails to recognize such people, they will make drone YouTube videos after discharge, and national defense will be left empty-handed.

In May 2026, there was one movement. The United States and South Korea signed a memorandum of understanding for a "Drone Alliance" in Seoul. According to Stars and Stripes, the head of the Ministry of National Defense's Defense AI Planning Bureau and the U.S. Army deputy assistant secretary for defense exports and cooperation agreed to build a joint supply chain for drone and counter-drone systems and establish common standards to improve interoperability. At Warrior Base near Camp Humphreys, U.S. and South Korean troops also completed a drone lethality training course together. The direction is being set. The problem is speed.

10-5 The Opportunity and Competition for South Korea's Defense Industry: Ranked Seventh in the Global Drone Market, Meeting Ukraine in the Export Market

South Korea's defense industry already stands at the center of the global stage.

In October 2025, President Lee Jae-myung declared that South Korea would become the world's fourth-largest defense power by 2030. According to Reuters, unmanned aircraft, AI-equipped weapons, and suicide drones were displayed at ADEX 2025.

According to an expert interview reported by Asia Pacific Defence Reporter (APDR) in February 2026, South Korea's annual defense export contracts were approaching roughly \$23 billion, or 32 trillion won, as of 2025. The analysis said South Korea had become the second-largest supplier to NATO member states after the United States. Hanwha Aerospace recorded its highest-ever sales in 2025, at 26.61 trillion won, and Hyundai Rotem signed a K2 tank contract with Poland worth roughly 9 trillion won.

Where are drones within that picture?

In a 2017 report, the Asan Institute for Policy Studies assessed South Korea's unmanned aerial vehicle technology competitiveness as seventh in the world. It was an assessment closer to potential. Market dominance was a different story. China's DJI dominated the civilian drone market, while in military drones, the United States, Israel, Turkiye, and Iran proved their products through their own battlefields. Now Ukraine has joined that list.

Ukraine has become a drone industrial state in the middle of war. The war was the laboratory, and the front line was the quality inspection site. The Washington Post reported in September 2025 that Ukraine had about 500 drone manufacturers.

Wartime demand and export restrictions remain bottlenecks, but it is only a matter of time before the country becomes a drone exporter after the war. According to an interview in the Kyiv Independent, Ukraine has already opened weapons export offices in ten European countries and signed large-scale, decade-long drone export contracts with Gulf states including Saudi Arabia, the UAE, and Qatar.

For South Korea, this is both an opportunity and a warning. South Korea has a manufacturing base, semiconductors, batteries, communications, shipbuilding, and a

defense export network. KAI is developing an AI autonomous unmanned loyalwingman drone to fly with the KF-21 fighter. Hanwha and LIG Nex1 are working on loitering munition programs. According to Seoul's defense analysis, as of 2026, counter-drone systems are considered the fastest-growing category among South Korean defense startups.

But competitiveness in drone warfare is not created by a high-end product catalog alone. It requires a radio-frequency environment that changes every week on the battlefield, aircraft used like consumables, structures that soldiers can repair and reuse themselves, and fast contracting methods between civilian startups and the military. As 60 Minutes reported, Ukraine's innovation cycle is one week. From the moment a drone is sent to the front, that is enough time to receive feedback and release a new version. If South Korea's defense industry remains only in the existing model of "developing finished products for a long time and delivering them perfectly," it may be late in the drone market.

A drone is less like a perfect luxury handbag than a combat uniform that is repeatedly torn, patched, and worn again.

10-6 North Korea's Order for Mass Production of Suicide Drones: What We Must Learn and What We Cannot Learn

On November 14, 2024, Kim Jong-un personally observed a test of suicide attack drones. According to KCNA, "suicide attack drones with various striking ranges" developed by the Unmanned Aerial Technology Complex and affiliated companies carried out precision strike missions against ground and maritime targets. Kim ordered officials to "establish a serial production system as soon as possible and enter full-scale mass production." CNN described the drones as "self-detonating drones" and analyzed them as asymmetric weapons that would be difficult to intercept if deployed in large numbers, like Iran's Shahed-136.

Four months later, in March 2025, North Korea took another step. It publicly revealed tests of suicide drones and reconnaissance drones equipped with AI technology. According to GlobalSecurity.org, North Korea also unveiled for the first time what

appeared to be an airborne early-warning aircraft system. Suspicions of Russian technology transfer followed. NHK reported in February 2025 that Russia had agreed to support North Korea with technology for mass-producing several types of drones. In a June 2025 interview, Lieutenant General Kyrylo Budanov, head of Ukraine's military intelligence agency GUR, said Russia was helping North Korea produce the Garpiya and Geran long-range suicide drones domestically, modeled on the Iranian Shahed-126. War on the Rocks described this as a "Deadly Drone Bonanza" coming to a peninsula nearby.

This probably does not mean North Korea has built world-class AI autonomous drones. But what it has learned is not the technological peak. It has learned the direction of war. Build many cheap platforms, combine reconnaissance and strike, and raise the defender's costs. For North Korea, with its severe economic constraints, drones that can threaten South Korea's expensive assets for a few hundred dollars are an irresistible asymmetric card.

What we must learn is clear. We must accept the asymmetry of unit cost. We must densely deploy systems for detecting, identifying, and neutralizing small drones around the Seoul metropolitan area and critical infrastructure. Whether to shoot them with guns, cut them off with radio waves, burn them with lasers, or catch them with nets, the answer must differ by site. The "Republic of Korea Drone Attack and Defense Competition" hosted by the Ministry of National Defense in March 2026 can be seen as the beginning of this direction. It was the country's first two-sided mock combat demonstration in which attacking drone teams and defending counter-drone teams competed in real engagement scenarios. Prize money of 152 million won and a demonstration-test budget of 2.5 billion won were attached.

But there are also things we cannot learn.

When the commander of Ukraine's Nemesis Regiment was asked about artificial intelligence and autonomous weapons in an interview with the Kyiv Independent, he answered this way: "Our policy is that decisions are always made by a human. Artificial intelligence can help, but it cannot make decisions." In the same interview, he said this about Russia and China: "They won't care about these issues."

North Korea is the same. Totalitarian states can cross red lines around civilian misstrikes, operator safety, and the ethical constraints of AI autonomous weapons without hesitation. South Korea cannot do that, and must not do that. The task before South Korea is to preserve ethical lines while overwhelming the speed of the enemy's autonomous weapons. This is why South Korea must independently develop defensive AI technology and computational tactics that assist human judgment at extreme speed.

Preparation for drone warfare on the Korean Peninsula must have three layers. Defense, offense, and an industrial ecosystem. Seoul and the capital region, airports, ports, power plants, LNG facilities, and data centers need systems to detect and neutralize small drones. South Korea needs low-cost mass platforms that can monitor and strike North Korean artillery, air-defense networks, command posts, and mobile launchers. It needs an ecosystem of parts, batteries, sensors, communications, and AI that runs as civilian industry in peacetime and shifts to military production in crisis.

Universities, startups, reservists, gamers, electronics engineers, AI developers, and major defense companies cannot spend their time distrusting one another and producing three volumes of meeting minutes. Drones grow old in conference rooms.

The small dots in the sky over Seoul in December 2022 disappeared. But the questions they left behind are still suspended in the air. Are we preparing only for a large war? Or are we also preparing for a war in which small machines shake a large order?

Ukraine has shown an answer written in blood. War no longer moves only across a general's map. It has descended onto a soldier's fingers, the soldering of civilian factories, the code of startups, and communications modules that endure under jamming. The Korean Peninsula cannot treat that battlefield as a story from a distant country.

The North Korean drone that passed through the sky over Seoul was a preview. The main feature has not yet begun.

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Epilogue "History Is Being Made Now"

The morning at the front always betrays yesterday's field manual.

Before a soldier raises his head above the trench, he looks at the sky. There are no fighter jets there. No bombers are visible. Instead, a palm-sized machine hums low overhead. It is neither bird nor bullet. But the soldier knows. That small sound can change the fate of the day.

War has always changed itself this way. From horse to tank, from trench to blitzkrieg, from aircraft carrier to missile, and now to drones launched from a soldier's fingertips. The issue is not that weapons have changed. It is that weapons now change faster than human institutions and common sense. Tactics from six months ago no longer fit, like old clothes. A frequency that worked yesterday is jammed today. A flight path that got through last week becomes a road to death this week. On the Ukrainian battlefield, the calendar of tactics turns not by season, but by week.

The commander of the Nemesis Regiment once said this in an interview with the Kyiv Independent. "War is changing. Previously, it changed more slowly. Once a year, once every six months. Now, any tactical change can happen in just a few months." He paused for a moment and added, "History is being made now. The future has already arrived, and documentation is lower on the priority list."

It meant there was no time to write the manual. While doctrine is being organized, the battlefield changes again.

On May 30, 2026, Ukrainian forces faced 8,549 loitering munitions deployed by Russian forces in a single day. That same day, Ukrainian forces shot down 1,781 Russian drones. Think about those numbers. Thousands of machines fly over the front in one day, and thousands fall in one day. A battlefield that used thousands of drones a year at the start of the war in 2022 now consumes that many in a day. War has moved beyond a war with drones. It has entered a war of how quickly drones can be made, lost, and changed again.

Net tunnels have appeared over roads. Nets that were once used for farming or fishing now cover front-line roads. A makeshift device that once protected tanks has become an everyday passageway for soldiers and vehicles, and beneath those nets, ground robots wrapped in camouflage netting run with boxes of ammunition. According to Business Insider, in 2026 Ukraine installed anti-drone nets over hundreds of kilometers of front-line roads. It is enough to cover the length of the state of Florida. The age of trenches and barbed wire has not disappeared. A new layer has been placed on top of it. The battlefield is no longer a space of earth and steel alone. It has become a place where radio waves, video, algorithms, fiber optics, batteries, and plastic frames are tangled together.

A new chapter is opening on the ground as well. In April 2026, President Zelensky ordered the production of 50,000 ground robots this year. In the first half of 2026 alone, 25,000 unmanned ground vehicles (UGVs) had already been contracted, nearly twice the total volume contracted in all of 2025. According to Defense News, a ground robot caught up with an elderly woman who had walked for hours through the Lyman gray zone, past shell craters and the bodies of neighbors. The robot evacuated her. More than 200 companies produce ground robots, 167 units are already operating them, and in the first quarter of 2026 alone, ground robots carried out more than 24,500 missions.

One commander said it this way. Robots do not bleed.

It is a cold sentence. But inside that coldness lies the desperation to save soldiers.

But the moment we say machines are fighting the war instead of humans, we lose sight of the center of this war.

Drones do not become angry on their own. Robots do not decide on their own to defend their homeland. Algorithms do not remember humiliation, nor do they place a finger on the map of the country and fall silent. Machines carry out orders. People decide the direction.

The commander of the Nemesis Regiment said this about artificial intelligence. "Artificial intelligence can help, but it cannot make decisions. We cannot delegate to

artificial intelligence the destruction of targets. To fly and hit something, whether it will do it correctly or not. No, the decision must always be made by a person." When asked whether this was a matter of ethics, he answered, "First, it is about the effectiveness of the work. We need to know what we are striking."

There are moments when effectiveness and ethics point in the same direction. A strike not verified by a person can miss, and a missed strike eats away at the cause of the war. Letting a machine replace judgment may make things faster, but fast is not the same as right.

Of course, there is a logic on the other side as well. Asked what Ukraine should do if Russia and China develop autonomous weapons without ethical limits, the commander answered this way. "We are not responsible for Russia or other countries. We are responsible for our army, our defense forces, our units." This answer is less an ethical declaration than battlefield pragmatism. Whatever the opponent does, it is better for one's own organization to preserve the chain of accuracy and responsibility in targeting.

No one knows how long this boundary can hold. If the speed of war rises further, there will be less room for human decision to intervene. What happens then is a story not yet written.

The strength Ukraine has shown was not only the strength of technology. It was the strength of how technology was accepted.

The cycle of discarding failed weapons, copying successful devices, sending feedback from the field to the factory, and sending improved products from the factory back to the front. The speed at which a new version appears in a week. The fact that 99 percent of the drones on the front are domestically produced. That cycle was created not by servers or production lines, but by people.

A former brewery engineer founded a private company and made drones to evacuate wounded soldiers. A twenty-five-year-old programmer in a hoodie stayed up all night writing code to bypass electronic warfare jamming zones. A commander who had led a platoon-sized drone unit became the world's first commander of a dedicated drone

military branch. What these people have in common is that they did things not found in the manual. Because the manual had not yet been written.

War was once a showroom for giant weapons systems. Bigger tanks, longer runways, more expensive vessels, more complex air defense networks. But the Ukrainian battlefield asked a different question. If a 300-dollar drone can stop a tank worth tens of millions of dollars, where should the arithmetic of the defense budget be rewritten from? If a country with a weak navy can force the Black Sea Fleet to pull back with unmanned surface drones, where does the center of maritime strategy move? If ground robots carry supplies, pull out the wounded, and watch enemy positions, what form does battlefield courage take now?

When Western soldiers came to meet a Ukrainian drone commander, they showed him their country's latest unmanned system and asked for his opinion. The commander asked, "How does it work? How is the connection secured?" After hearing the answer, he said, "What happens if there is no GPS?" They said, "Why would there be no GPS? There are satellites." The commander answered, "There will be no GPS." They were silent for a moment, then said, "We do not know what will happen next."

When they came back after some time had passed, they brought equipment to strengthen the GPS signal. The commander said, "We used that equipment a year and a half ago. Today, it does not work." They said, "Damn, we bought hundreds of them."

This conversation tells us something. Between an army that has not fought this war directly and an army that lives inside it every day, there is a gap of experience, and that gap cannot be filled with money.

The Nemesis Regiment's 2026 record shows the size of that gap in numbers. According to United24 Media, the Unmanned Systems Forces struck 174 Russian air defense systems in 2026 alone, with estimated damage reaching 5.4 billion dollars. A new command structure called the Deep Strike Center was created, and the strike range expanded from air defense systems in Crimea to ships at the Kronstadt Naval Base near Saint Petersburg.

The Unmanned Systems Forces, which account for only 2 percent of the defense forces, destroy one in three confirmed enemy targets and shoot down one in three cruise missiles. This ratio is a number about organizational efficiency, but it also means that the remaining 98 percent of the military has not yet shifted to this method. The shift is under way, and Russia also announced the creation of its own Unmanned Systems Forces in December 2024. Both sides are changing, and they are competing over the speed of that change.

So the lesson of this war is not worship of technology.

Victory does not automatically follow because a new weapon appears. The army with more drones does not necessarily win. The army that learns faster, the army that does not hide failure, the army that breaks down the walls between young operators, engineers, and commanders in the field, survives. An organization where rank crushes ideas fights an old war even with the latest equipment. By contrast, even a device made in a small workshop can shake the board of strategy if it strikes precisely at a problem on the front.

The advice the drone commander gave to Western militaries was not grand. "Start small. Start by thoroughly studying the experience of the Russia-Ukraine war. This is the war everyone will have in the future. And do not invest all your money in armored vehicles, artillery, and traditional means of war."

The reason Ukraine was able to stand against a giant lies along the same line. It was not because its territory was larger. It was not because its population was greater. It was not because everything had been prepared perfectly. Instead, it was hit while unprepared, came close to collapsing, and held on each time in a different way. In that process, the state became a laboratory, the front became a research institute, and soldiers became developers.

But the moment we package this story as a heroic tale, we lose the center again. Near the end of the interview, the commander of the Nemesis Regiment said this. "There has never been an easy time at the front. From the beginning of the war, I do not remember easy moments. Even after we achieved certain successes, after the offensives in Kherson, Kharkiv, and Kursk Oblast, I remember the great spirit of

success. But I remember the pain we had to pay for that price."

"Do I feel that we are losing? Yes, I do. We are slowly retreating. But I believe this is a fully controlled process. We are not collapsing. We are retreating in a controlled manner."

There is no bluff in these words. And there is no despair. The voice of a soldier at war lives somewhere between the two. The voice of someone who cannot be sure of victory, but does not give up.

History always appears afterward like a completed sentence. The sentences in textbooks are decisive. In such-and-such year and month, such-and-such battle, such-and-such treaty, such-and-such victory or defeat. But real history does not arrive like that. It is made beside a broken radio, at the fingertips changing a battery, in the eyes watching whether software updated overnight will work in the dawn attack.

After the war ends, people will say it. That was when the character of war changed. That was when a small country shook the way a large country fought. That was when small machines flying low in the sky made the world's military doctrine be written again.

But for the people now on that scene, it is not "history." For them, it is survival tonight. Can they save a comrade? Can they find the enemy's artillery battery? Can they reconnect a broken line of communication? Can they fly again today the equipment left behind by someone who died yesterday? History begins that way, without a grand name tag, amid dust and blood and front-line cables and the smell of solder.

Ukraine's drone war is not over yet. Even as this epilogue is being written, drones are flying, falling, and being made again. So the conclusion is not closed either.

Only one thing is already visible.

The future of war is not being quietly invented in some distant laboratory. It is being made now on the front, by people who reassemble failed aircraft.

History is being made now.

And it is being made not by machines, but by people who refuse, in the end, to give up.

Notes

The remarks by the commander of the Nemesis Regiment quoted in this epilogue are excerpted from the Kyiv Independent interview "West not ready for modern war, Ukrainian drone commander says."

The battlefield data for May 30, 2026, refers to EMPR Media's daily battlefield report, Russia Ukraine War Updates, May 30, 2026.

The 2026 record of strikes by the Unmanned Systems Forces against air defense systems, 174 systems and an estimated 5.4 billion dollars in damage, is cited from United24 Media reporting dated June 6, 2026.

The status of front-line anti-drone net installation and analysis of Russia's expansion of jet-powered drones refer to Business Insider reporting from June 2026.

The data on the order to produce 50,000 ground robots, the contract for 25,000 units, operation by 167 units, and 24,500 missions were cross-checked against reports by Defense News on May 8, 2026, United24 Media in May 2026, and Euromaidan Press on April 28, 2026.

The status of participation by more than 200 ground robot companies refers to reporting by Militarnyi and an op-ed by Fedorov, Ukraine's minister of digital transformation.

Appendix

Drone War: How Ukraine Is Rewriting the Grammar of War

Appendix A Key Drone Specifications

FPV, Long-Range Strike, Maritime, Ground, and Interceptor Drones

The main text said that drones have changed war. This appendix is the worksheet that shows what numbers that claim rests on. Length: 6 meters. Speed: 90 km/h. Range: 1,000 km. Combat payload: 850 kg. These figures are cold, but they are also sentences that have rewritten the grammar of war in practice.

One point must be made in advance. The specifications of wartime drones are not data plates etched into metal. They are closer to a blackboard on the front line, constantly erased and written over. Even for the same model, manufacturer announcements, public exhibition materials, battlefield reports, and Wikipedia entries often give different numbers. Upgraded versions appear often, and units modify airframes in the field. This table identifies sources where possible, but figures that cannot be confirmed are marked as "public estimates."

1. FPV Drones (Small First-Person-View Suicide Drones)

The weapon that has caused the most casualties in this war is neither the strategic bomber nor the missile. It is the FPV drone, small enough to fit in the palm of a hand and made from hobby parts and 3D-printed components.

Unit cost: about \$300 to \$1,000 (New York Post, February 2025 report) Control method: directly guided by a pilot wearing first-person-view (FPV) goggles Operating range: about 15 to 30 km by radio; fiber-optic drones have shorter ranges but are immune to electronic warfare Top speed: 120 to 200 km/h, depending on model Warhead: varies from standard grenade-class charges to anti-tank shaped charges Innovation cycle: about one week from front-line feedback to release of a new version Production scale: Ukraine built an annual production system of about 4 million units in 2024 (60 Minutes

report)

FPV drones fly low over trenches to track soldiers, aim for gaps in tank hatches, and slip into shelters. According to Wang Zhian's analysis, the combat radius of the FPV drones used in Operation Spider's Web was only 15 to 20 km, but because they had been smuggled into Russian territory in advance and launched locally, they were able to strike targets 4,300 km away.

2. Long-Range Strike Drones (One-Way Attack Drones)

These are the weapons that pushed the boundary of the front thousands of kilometers into the rear. Ukraine operates several domestically produced long-range suicide drones, and as of 2026, 100 to 200 are launched toward Russian territory every day.

(a) AN-196 Liutyi Manufacturer: Antonov ASTC Takeoff weight: 250 to 300 kg Warhead: 50 to 75 kg Range: 1,000 to 2,000 km (varies by configuration) Unit cost: about \$200,000 Navigation: combination of AI, satellite navigation, and inertial navigation

Note: A Ukrainian domestically produced long-range airframe designed as a counterpart to Iran's Shahed-136. It is relatively expensive, but its long range and large warhead make it useful against strategic targets.

(b) Bober ("Beaver") Range: about 1,000 km Warhead: about 20 kg Features: distinctive canard layout, streamlined fuselage, and inverted tail. Since appearing in 2023, it has entered mass production and has been used repeatedly in strikes on targets inside Russia, including Moscow.

(c) AQ-400 Scythe Manufacturer: Terminal Autonomy (formerly One Way Aerospace) Takeoff weight: 100 kg Warhead: 32 to 43 kg (can be increased to 70 kg with reduced range) Range: about 750 km Top speed: 200 km/h Unit cost: about \$30,000

Note: Developed by a company founded in mid-2022 by former British and Australian military personnel and Ukrainian engineers. Demonstrated in spring 2023, with first deliveries in December of the same year. It is designed for low-cost mass production and can operate in leader-follower mode during swarm flight.

(d) FP-1 Warhead: up to about 120 kg Range: about 1,600 km Features: mainly made of plywood. According to an April 2026 report by DroneXL, it is estimated to account for about 60 percent of strikes inside Russia.

(e) Sichen Range: about 1,400 km (870 miles) Features: unveiled in 2026. It was reported to carry a smaller warhead than the FP-1 or Liutyi, but to have longer range and greater resistance to electronic warfare.

The exact specifications of these models vary across public sources because of wartime security, frequent upgrades, and manufacturer-specific variants. The figures listed here are therefore not "confirmed values" but "estimates based on reporting."

3. Maritime Drones (Unmanned Surface Vessels, USVs)

Ukraine effectively has no navy. Yet it forced Russia's Black Sea Fleet to retreat. Maritime drones did that work.

(a) Sea Baby Developer: Security Service of Ukraine (SBU) Length: 6 m; width: 2 m; height above waterline: 0.6 m Warhead: up to 850 kg (Wikipedia); SBU official video mentions a 940 kg warhead Range: at least 1,000 km (the 2024 upgraded version was reported to exceed 1,500 km) Top speed: 90 km/h (about 49 knots) Unit cost: \$221,000 according to the UNITED24 fundraising platform; Wikipedia gives 8.5 million hryvnias (about \$245,000, 2025 basis) Armament: can be fitted with a gyro-stabilized 14.5 mm machine gun. Missile-carrying trials completed

Note: SBU chief Vasyl Maluk led the concept for a next-generation maritime platform beginning one year earlier. It is known to have struck the Crimean Bridge "from below, from under the water." The SBU says it evolved from an early "suicide drone reminiscent of a Cossack galley" into an advanced maritime platform capable of carrying missiles.

(b) Magura V5 Developer: Group-13 under Ukraine's Main Directorate of Intelligence (GUR) Length: about 5.5 m; width: about 1.5 m; draft: about 0.4 m Full-load displacement: about 1.1 tons Warhead: 250 to 350 kg (varies by source. The Group-13 commander gives 250 kg; SpetsTechnoExport presentation materials give 320 kg) Range: about 800 km (more than 400 nautical miles) Cruising speed: about 22 knots; top speed: about 42 knots (some claims cite a burst speed of 54 knots) Unit cost:

\$250,000 to \$300,000 Control: internet connection through Starlink satellite, with backup control channels Hull material: plastic (difficult to detect by radar)

Note: In February 2024, it became the first maritime drone in history to sink an enemy warship. It sank the Russian missile corvette Ivanovets and landing ship Tsezar Kunikov. Within one year of being unveiled, it had sunk eight Russian warships and damaged six, with estimated damage exceeding \$500 million. Ukraine said it could produce up to 50 units per month. US Naval Institute Proceedings summarized this in its September 2025 issue.

(c) Magura V7 The successor to the Magura V5. At about 7.5 m long, it is larger than the V5, and its bow shape was changed to improve stability in waves. According to naval analyst H.I. Sutton, it has been confirmed carrying two AIM-9L Sidewinder air-to-air missiles in a "FrankenSAM" configuration.

4. Ground Drones (Unmanned Ground Vehicles, UGVs)

They are less dramatic than drones in the sky, but these machines are changing war close to soldiers' ankles.

Armed type: fitted with a .50 caliber (12.7 mm) machine gun or 40 mm grenade launcher. It fires on enemy infantry in front of trenches and withdraws. Transport type: carries ammunition, food, and wounded soldiers between the front and rear. A Radio Free Europe report shows an armored drone built by a former brewery engineer recovering bodies and evacuating wounded soldiers. Defensive type: 60 Minutes reported one case in which a ground drone single-handedly repelled Russian attacks for 45 days.

"Tanks don't go where we drive." That is what the commander of a ground drone unit on the Pakovsk front told Radio Free Europe. "It is better to lose a machine than a person." This sentence sums up why ground drones exist.

The number of models is highly varied. Ratel, Lyut, the Droid TW family, and Tech Core's casualty evacuation drone are known examples, but there are also many improvised types made by units at the front by modifying or welding together off-the-shelf equipment. This is a category where the mission matters more than speed

or weight.

5. Interceptor Drones

As Russia poured dozens to hundreds of Iranian Shahed-series suicide drones into Ukraine each night, Ukraine could not hold out with expensive air-defense missiles alone. A single Patriot PAC-3 missile costs more than \$3 million, and a NASAMS round costs more than \$1 million, while CSIS estimates the production cost of one Shahed at only about \$35,000. The math did not work.

So interceptor drones appeared.

(a) Sting Developer: Wild Hornets Type: quadcopter interceptor drone and loitering munition Unit cost: about \$2,100 to \$2,500 Top speed: 315 km/h (nearly twice the Shahed cruising speed of 185 km/h) Engagement distance: up to 25 km Preparation time: launch within 15 minutes after detection If no target is found: autonomously returns to save resources Production scale: more than 10,000 units per month as of March 2026 Combat results: more than 7,000 Shahed/Geran-series drones shot down as of May 2026 (manufacturer claim)

Note: In December 2025, it first shot down a Russian Geran-3 fitted with a jet engine. As of April 2026, Sting accounted for 70 percent of jet-type Shahed shootdowns. In April 2026, a Sting launched from an unmanned surface vessel also set the world's first record for intercepting a Shahed from such a platform.

(b) P1-SUN Developer: Skyfall Unit cost: about \$1,000 Top speed: more than 300 km/h

Note: The manufacturer said it could produce up to 50,000 units per month.

(c) Octopus Developer: Ukrspesystems / TAF Drones Industries Top speed: 300 km/h Engagement radius: 30 km Altitude: 4,500 m Warhead: 1.2 kg Endurance: 15 minutes

Note: AI-based automatic terminal guidance. Under a joint production project with the United Kingdom, production was planned at 1,000 units per month starting in February 2026.

(d) Zerov-8 Developer: WIY Drones Top speed: 326 km/h Engagement radius: 20 km
Features: tilt configuration that takes off and lands vertically, then transitions to horizontal flight. As of January 2026, production was 100 units per day, with a unit cost of about \$2,300.

According to a March 2026 report by Defense News, Ukraine produced 100,000 interceptor drones in 2025, an eightfold increase over the previous period. As of February 2026, Commander-in-Chief Syrskyi said interceptor drones were responsible for more than 70 percent of Shahed interceptions in the Kyiv region.

Appendix B Organizational Chart of Ukraine's Unmanned Systems Forces (SBS)

The Unmanned Systems Forces (Сили Безпilotних Систем, SBS) is an organization born during war. It was not a force slowly planned in peacetime staff meetings, but one that grew quickly between trenches, factories, and startup offices. If the organizational chart of a conventional military was fixed by branch and rank, this one moves through missions and feedback loops.

1. Creation

In February 2024, President Zelensky ordered the creation of a dedicated drone service branch. In June 2024, Ukraine officially launched the world's first dedicated service branch for unmanned systems. Its first commander was Vadym Sukharevskyi. In June 2025, Robert "Madiar" Brovdi was appointed as the new commander. The official website (usforces.army) introduces him as a Hero of Ukraine and commander of the Unmanned Systems Forces.

2. Scale and Status

Share within the defense forces: about 2 percent of the total (planned expansion to 5 percent) Combat results: "One in every three confirmed enemy targets is being destroyed by the Unmanned Systems Forces." (Commander Madiar's recruitment video) Cruise missile shootdowns: "One in every three cruise missiles is being shot down by the Unmanned Systems Forces, and soon it will be one in every two." As of February 2026: According to Commander-in-Chief Syrskyi of the Ukrainian Air Force,

more than 105,200 enemy targets were struck in one month, and one-quarter of them were the work of dedicated SBS units. (Jamestown Foundation, April 2026 report)

3. Order of Battle (as of March 2026)

According to an April 2026 analysis by the Jamestown Foundation, the SBS order of battle consists of five brigades, nine regiments, and twelve independent battalions, including maritime drone units. Combat support elements include signals intelligence, information operations, and engineer units, while sustainment assets include logistics, communications, and training centers.

The main units are as follows.

(a) 412th Independent Unmanned Systems Brigade "Nemesis" Created as a battalion on December 29, 2023, then expanded into a brigade. Mission: destroy enemy air-defense systems, disrupt supply routes, and strike artillery, positions, equipment, and personnel. According to a Kyiv Independent interview with the commander of the Nemesis Regiment, "Already this year, our regiment has destroyed more than \$1 billion worth of enemy air-defense assets." Features: "We cultivate creativity and apply a business approach. We break everything down into business processes with efficiency indicators and standardized solutions."

(b) 411th Independent Unmanned Systems Brigade "Hawks" Created as a battalion in February 2022 and expanded into a regiment in December 2024. It originally belonged to the Territorial Defense Forces, but its innovative training methods were recognized, and in November 2025 it was transferred to the Unmanned Systems Forces Command. Garrison: Kyiv.

(c) 427th Independent Unmanned Systems Brigade "Rarog" Created in April 2023 as a company under the 24th Mechanized Brigade. Participated in the Battle of Bakhmut. It expanded step by step from battalion to regiment in February 2025, then from regiment to brigade.

(d) 414th Independent Unmanned Strike Aviation Brigade "Birds of Madyar" Originated from the unit directly led by Commander Madiar. It expanded into a brigade in January 2025 and was transferred to the Unmanned Systems Forces in September 2025.

Includes the Adam Tactical Group under its command. In November 2024, it destroyed a Borisoglebsk-2 electronic warfare complex with a Vampire long-range attack drone.

(e) "Phoenix" Unmanned Systems Regiment Under the "Pomsta" Brigade of the State Border Guard Service. The largest and highest-performing UAV unit within the border guards.

The 20th Independent Regiment "K-2," 429th Regiment "Achilles," and others were also incorporated into the SBS group.

4. Drone Organization Within Each Army Brigade

Separate from the SBS, every Ukrainian Army brigade forms its own unmanned aerial complex (UAC) battalion. Each mechanized battalion has a UAC platoon, and each brigade reconnaissance company has nine drone operating squads. The SBS exists in parallel with these units and serves as a "central hub" that spreads accumulated research-and-development results and operational experience across the entire military.

5. Madiar's 100-Day Plan

The core of the 100-day plan announced immediately after his appointment in June 2025 was to build "12 layers of SBS influence" across tactical and operational depth. Defense Minister Umerov explained it this way: "We combine infantry and UAVs into a single strike system. Through this, we create a kill zone 10 to 15 km deep and make it impossible for the enemy to move without losses."

6. Recruitment

According to Commander Madiar's recruitment video, more than 15,000 vacancies are open, half of them civilian professional roles. Electronics engineers, programmers, designers, project managers, "technicians in every field," and drone pilots are needed. "Running around is good, but the time has come to fly. While destroying the occupiers."

7. Russia's Response

Russia also announced the creation of its Unmanned Systems Forces (VBS, Войска Беспилотных Систем) in December 2024 and began operating them in November 2025. It created UAV staff sections at strategic, operational, and tactical echelons, and organized UAV departments at division, brigade, and regimental headquarters. According to the Jamestown Foundation's assessment, however, Russia's daily FPV drone production capacity is estimated at about 19,000 units, while Ukraine retains a quantitative advantage in multirotor FPV drone operations.

Appendix C Timeline of Major Ukrainian Drone War Operations (2022-2026)

2022

February 24 Russia begins its full-scale invasion. In the early phase of the war, Turkish-made Bayraktar TB2s appear in the skies over Ukraine. A medium-altitude long-endurance unmanned aircraft, according to manufacturer Baykar, it has reconnaissance and surveillance missions as well as autonomous takeoff, landing, and flight functions, with a maximum takeoff weight of about 700 kg, payload of 150 kg, endurance of more than 20 hours, and communication range of under 300 km. Videos of TB2s striking Russian supply columns spread worldwide, and Ukrainians even made a song about the TB2. Its symbolic meaning was large, but as Russian air defenses grew stronger, the TB2's tactical limits also became clear.

April 14 The Russian Black Sea Fleet flagship Moskva is sunk. Two Neptune anti-ship missiles are known to have hit it, and some analyses suggest a TB2 drone served as a decoy to distract attention.

October 8 First strike on the Crimean Bridge (Kerch Bridge). An explosive attack using a truck partially destroyed the bridge.

2023

Explosive spread of FPV drones. The camera of war descended from thousands of meters in altitude to a soldier's shoulder. Small FPV drones began to be built for \$300 to \$1,000 and started chasing trenches, armored vehicles, and supply trucks.

May First publicly known operation by the Magura V5 maritime drone. Three drones attacked and damaged the Russian intelligence ship Ivan Khurs, a 4,000-ton vessel.

December First delivery and deployment of the AQ-400 Scythe long-range drone. The Bober (Beaver) long-range drone also entered mass production.

2024

February The Magura V5 becomes the first maritime drone in history to sink enemy warships. It sinks the missile corvette Ivanovets and the landing ship Tsezar Kunikov.

February President Zelensky orders the creation of the Unmanned Systems Forces.

June The world's first dedicated unmanned systems service branch, Ukraine's Unmanned Systems Forces (SBS), is officially launched.

In this year, drones became the main cause of about 80 percent of battlefield casualties, and the "drone-centered battlefield" became fixed in place. Ukraine's annual drone production scale reached about 4 million units.

December Russia announces the creation of its Unmanned Systems Forces (VBS).

2025

February President Zelensky launches the "Drone Line" initiative.

Early June Madiar (Robert Brovdi) takes office as SBS commander, and five initial incorporated units are designated: K-2 Regiment, Achilles Regiment, Rarog Regiment, Birds of Madyar Brigade, and Phoenix Regiment.

June 1 Operation Spider's Web is executed. Executing body: Security Service of Ukraine (SBU) Preparation period: more than 18 months Method: 117 FPV drones and 300 explosive devices were hidden in containers disguised as wooden structures, moved by long-haul trucks to areas near Russian air bases, and remotely launched through Russian civilian cellular networks. Bases struck: Olenya (near Murmansk), Dyagilevo (Ryazan), Ivanovo Severny (Ivanovo), Belaya (Irkutsk, 4,300 km from the front), Ukrainka (Amur, believed to have failed) Damage: Ukraine claimed 41 aircraft destroyed; NATO estimated 10 to 13 completely destroyed; U.S. officials estimated

about 20 aircraft hit, with 10 destroyed Aircraft damaged: Tu-95MS strategic bomber, Tu-22M3 bomber, Tu-160 strategic bomber, A-50 airborne early-warning aircraft Costratio: estimated operational cost under \$5 million; estimated damage about \$7 billion(Ukrainian side) Civilian drivers: Of five Russian civilians who drove the trucks, one died in an explosion, and four were arrested by the FSB and charged with terrorism Reuters reported the method of the operation, preparation period, number of drones, and scale of damage.

June 5-6 Russian retaliatory attacks. 452 aerial attack assets used.

November Russia's Unmanned Systems Forces begin operations.

November Sting interceptor drones claim more than 1,000 Shahed-series shootdowns in the four months after mass production begins.

December Sting first shoots down a Russian Geran-3 fitted with a jet engine.

Annual: 100,000 interceptor drones produced (announcement by Ukraine's National Security and Defense Council).

2026

January Daily interceptor drone production surpasses 1,500 units. In the same month, 1,704 Shaheds are recorded as shot down (announcement by Commander-in-Chief Syrskyi).

February Interceptor drones account for more than 70 percent of Shahed interceptions in the Kyiv region.

February Every day, 100 to 200 long-range drones are launched toward Russian territory.

March At the request of the United States, Ukraine sends interceptor drones and drone warfare specialists to a U.S. military base in Jordan. (New York Times interview with Zelensky)

March Sting monthly production exceeds 10,000 units.

April-May Maritime and long-range strike drones carry out a series of strikes on Russian energy and oil-refining facilities, including Tuapse on the Black Sea coast, Leningrad, and Primorsk.

May 1 A new security agreement, including air-defense support, is signed between the United States (Trump administration) and Ukraine.

May 16 First round of Turkish-mediated peace talks collapses.

June 2 According to AP reporting, Russia carries out a large-scale air raid using 73 missiles and 656 drones at the same time.

Early June The Unmanned Systems Forces announce a large-scale recruitment drive for 15,000 personnel.

June SBS order of battle: five brigades, nine regiments, twelve independent battalions (Jamestown Foundation analysis).

June Just Security publishes "How Ukraine Became a Drone Superpower."

Appendix D Main Sources and References

The references for this book are organized into four streams.

1. Official Materials

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4. Primary Materials Within the Nanum Knowledge Project

The 11 YouTube transcripts collected and cleaned for research for this book are managed as separate files.

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Manufacturer materials help in understanding performance, but they carry the temperature of advertising. This book distinguishes among "public specifications," "reporting-based figures," "estimates," and "difficult to confirm."

Note

The figures and dates in this appendix were prepared based on publicly available materials as of June 9, 2026. The war is ongoing, and drone technology changes every week. Some of the figures in this table will already be old by the time this book is printed.

The appendix sits quietly behind the main text, but in truth it is the worksheet handed to the reader. If the main text said drones have changed war, the appendix shows which numbers, which dates, and which organizations that claim stands on. Records that survive for a long time usually endure beside dates, specifications, and sources.