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A Never-Ending Supply of Drones Has Frozen the Front Lines in Ukraine

The speed and scale of production means soldiers can't emerge from their bunkers without falling prey to a drone

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In the battle for Ukraine, the front line is increasingly at a standstill. The reason: rapid innovations in drone technology.

From just a few commercial and homemade drones, which the Ukrainians used at the start of the war to locate invading Russian columns, unmanned vehicles now dominate the battlefield.

Each side has hundreds of them constantly in the air across the 750-mile front line. Drones can lay mines, deliver everything from ammunition to medication and even evacuate wounded or dead soldiers. Crucially, drones spot any movement along the front line and are dispatched to strike enemy troops and vehicles.

'Wedding drones' at war

When Russia sent tank columns into Ukraine in February 2022, Ukraine needed to find out where they were headed—and fast.

Enter the humble "wedding drone," available in stores for about $2,000 and repurposed to scan for enemy units rather than capture nuptial panoramas.

Deployed by enthusiasts acting independently or attached to army units, the drones helped Ukrainian forces, which were vastly outnumbered and outgunned, to know exactly where to deploy to counter Russian arrowheads.

Drones turn deadly

Surveillance drones quickly became a necessity rather than a luxury. Often provided by charity funds, they were used to scan enemy positions for equipment, stores and headquarters. At first, teams of analysts would watch screens of footage stored on memory

cards. Within a year of the full-scale invasion, the drones provided real-time images so artillery gunners could direct their fire onto a target.

A cheap and simple tweak made the so-called wedding drones deadly. Tech buffs realized that a simple claw-like contraption, created using a 3-D printer, could be activated from the radio controller by turning on the drone's light, causing it to release a grenade.

The explosion could wound or kill a soldier or even detonate an armored vehicle if dropped through its hatch.

Over time, soldiers experimented with ways to add more explosives, for example by melting down explosives garnered from Soviet-era munitions and pouring them into new, lighter plastic casings.

Suicide drones

No innovation has had a bigger impact on the war in Ukraine than first-person-view, or FPV, drones. With explosives strapped to them, FPVs fly directly into their targets, turning them into low-cost suicide bombers.

Though FPVs don't deliver as much explosive punch as rockets, they are far more accurate— and the sheer volume that Ukraine has manufactured means they can be deployed to similar effect.

FPV drone production in Ukraine

Year	Production
2023	0.8 million
2024	2.2 million
2025	At least 4.5 million
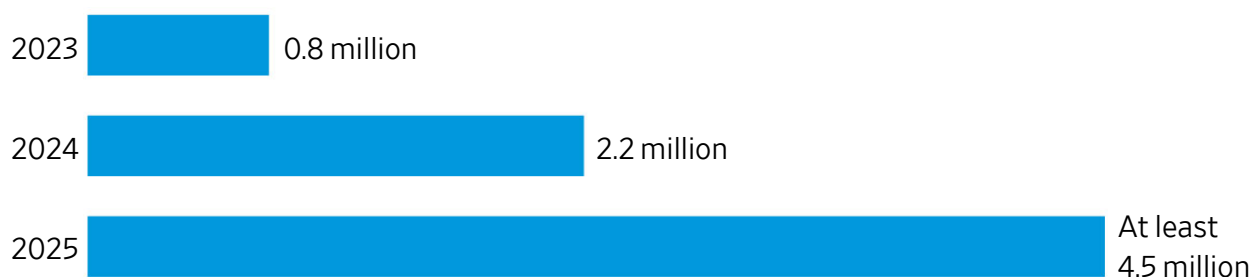
Note: 2025 are estimates
Source: Ukrainian officials

FPVs began appearing on the battlefield in 2022, but it was in late 2023 that they began reshaping it.

That winter, Ukraine was desperately low on artillery ammunition, as its forces waited on the U.S. to approve another military-aid package. FPVs became a lifeline, a way to mostly hold the Russians back using technology that—unlike rockets or missiles—could be manufactured domestically and cheaply.

A Ukrainian pilot operating an FPV drone during a repair-and-test session in April. PHOTO: VIOLETA SANTOS MOURA/REUTERS

Sitting in a bunker several miles behind the front, a drone pilot slips on FPV goggles to see the view from the drone's camera and fly it into an enemy position or asset. The Russians have since adopted FPVs en masse. Their abundance has played a central role in slowing down the movement of the front line. Anything within around 12 miles of the contact line can now become a target for FPVs. They are so cheap to make that both sides can expend them on any target—even a single infantryman.

Sometimes, FPVs are a menace far further from home: Ukraine smuggled a horde of FPVs hundreds of miles beyond the front line and piloted them remotely toward their targets in its audacious attack on Russia's strategic aircraft in June.

Because they are so small and fast, FPVs are difficult to shoot down. The main defense against them has been electronic jamming systems, which disrupt the communication between the drone and the pilot.

Fiber-optic drones

Though most drone innovations in the war have come from the Ukrainian side, the Russians pioneered the most important adaptation for FPV drones—the addition of a fiber-optic cable connecting the drone to the pilot that can overcome jamming.

By 2024, the threat from FPV drones had made resupplying troops at the front perilous. Ukraine found a workaround: the Vampire drone, so named in part because it can work after dark when equipped with night-vision cameras.
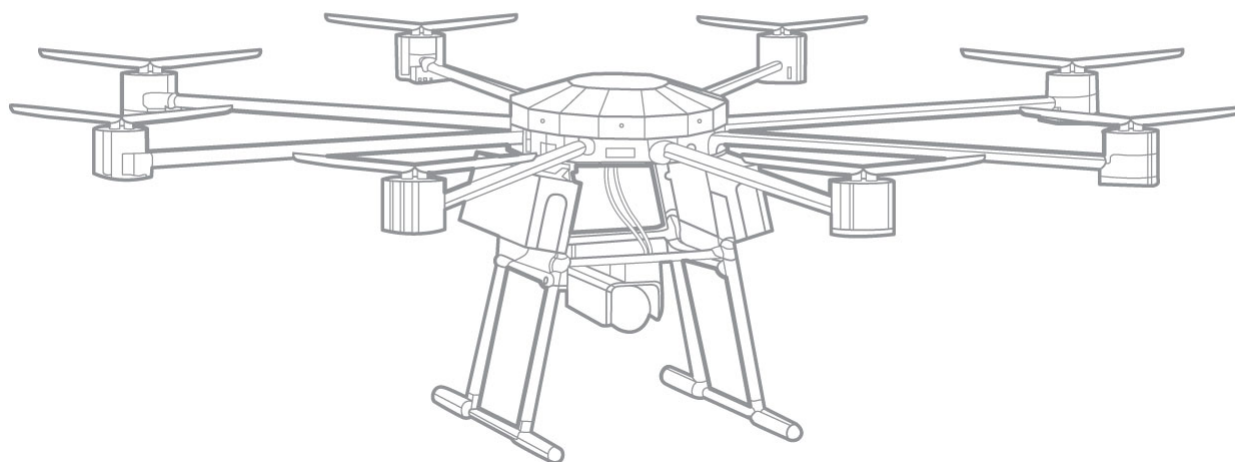
Vampire Night Drone

Max speed: Up to 25 mph
Flight range: Up to 6.2 miles
Payload: Up to 33 lbs.
Flight time with load: 23 mins.

Source: United24
Jemal R. Brinson/WSJ

Two-feet tall, with six or eight rotors, and able to carry up to 20 pounds, Vampires were originally used by Ukrainian forces to drop larger explosives than they could using smaller drones.

Land drones deliver the dead

The drones now bring everything from food and water to ammunition, power banks—and, in at least one case, a fire extinguisher—to the front, sparing soldiers trips through the most dangerous part of the battlefield where enemy drones might pick them off.

Ukrainian troops are also beginning to use land drones to move heavier loads than the Vampires can carry.

Drone manufacturers are now experimenting with remotely piloted cars, boats and all-terrain vehicles, which can be used to help with the evacuations of injured and dead soldiers.

Graphic sources: Institute for the Study of War and AEI's Critical Threats Project (areas of control); Armed Conflict Location and Event Data (ACLED) (drone attacks)

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