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Towards a mass UAV loitering capacity for the Royal Netherlands Army

Friso M.S. Stevens

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Abstract

Any high-intensity European land war with Russia is likely to involve hundreds of thousands to millions of attritable unmanned aerial vehicles (UAVs). In Ukraine, UAVs are now responsible for most casualties and system losses, not artillery. In the next 5-10 years, the lethality in what is at present a 10-15 kilometres zone of overlapping kill chains (extended-range reconnaissance-strike complexes), will make that terrain hard for humans to operate in—with or without armoured protection. At a time when European NATO moves to 3.5% of GDP spending on defence, the Royal Netherlands Army should establish a UAV loitering capacity accordingly. Looking at function, range, technological complexity, and cost, three options for acquiring a credible attack UAV capacity are spelled out. With rapid battlefield innovations, it should be tightly knit into a versatile, adaptable, and constantly innovating domestic UAV industry that learns from the bottom up through its own experiences as well as from the study of UAV applications in future conflicts.

Drawing lessons for contemporary warfare from Ukraine, the Royal Netherlands Army should establish a UAV loitering capacity.

Introduction

After the Cold War, European land power was transformed into lean expeditionary forces backed up by a limited number of the most advanced but costly air assets. Network-centric innovations provided for precision strikes,¹ foregoing the Cold War emphasis on mass to stop a Russian armed attack. However, as demonstrated on the battlefield of Ukraine, improved sensors and tracking technology (satellites, airborne intelligence, surveillance, and reconnaissance (ISR) assets, and first-person-view UAVs) combined with advances in short-range firepower have created an extraordinarily lethal environment for humans to operate in. As is the case in Ukraine, the future battlespace may hold a 10-15 kilometres zone with continuous and countless kill chains from both sides. Drawing lessons for contemporary warfare from Ukraine, this article argues that the Royal Netherlands Army should establish a UAV loitering capacity, following the Dutch Ministry of Defence's announcement of the Production Security Unmanned Systems Action Plan (APOS).

This military-technological development comes at a time when European NATO must prepare for war without the US, an ally that could be unable (because it is fully committed in the Asian theatre) or unwilling (because of America First nativism) to come to Europe's aid. Add to that the fact that in the past 35 years, NATO has fought extraterritorial wars of choice against technologically inferior weak states and non-state actors. US-commanded and US C4ISR-enabled, and covered by American air superiority, the assumption in European strategic thinking has been that Europe would operate in conjunction with the US as its junior partner. In turn, this allowed Europeans to similarly have an offensive operational doctrine based on manoeuvre. Now, European NATO must ready itself for the possibility of a long, drawn-out attritional war with Russia centred on holding ground somewhere in Finland, the Baltics, or Poland (or Romania and Bulgaria if Ukraine does not hold). This requires not only a partial refocus of procurement items but also one in mindset: a viable theory of victory where man and machine work hand in glove is needed. When it comes to UAVs, the procurement choices available for the Netherlands, described below, are informed by the tactical environment as well as the strategic effect that individual platforms can produce.

European NATO must ready itself for the possibility of a long, drawn-out attritional war with Russia centred on holding ground somewhere in Finland, the Baltics.

¹ See Arthur K. Cebrowski, "Network-Centric Warfare: An Emerging Military Response to the Information Age," *Military Technology* 5 (2003): pp. 16-17; Jon R. Lindsay, *Information Technology and Military Power* (Ithaca: Cornell University Press, 2020), pp. 13-14.

The technology-cost asymmetry

The most pervading innovation on display in Ukraine is the remotely piloted hunter-killer UAV. Consisting of few things more than (3D-printed) carbon fibre airframes, a motor propeller, a flight and electronic speed control system with a low-end processing chip, a first-person view (FPV) camera and transmitter, and a strapped-on explosive of 1 to 2 kilograms, they conduct one-way missions to seek out and then take out enemy tanks, artillery, and, increasingly, infantry. Its particular advantage, when compared to the MQ-1 Predator that was deployed in Afghanistan and Iraq in the 2000s, is its cost: a few hundred to a few thousand euros. An important implication of this low cost is the denting of the overwhelming imbalance in capital and technology that has existed between the leading OECD countries and weaker entities, such as the Houthis aided by Iran—some degree of (access to) advanced industry is required.² Indeed, with the connection between wealth and technology, and power and influence reduced,³ this levelling means that proximate actors that harbour adverse intent that could heretofore muster no material threat, are now able to challenge European core interests. A small power like Algeria may decide to act as a spoiler in the Mediterranean, for instance, in one hypothetical scenario.

Until now, the Western fleet of fighter jets with a “qualitative military edge” reigned supreme because it is technologically extremely complex and expensive, and cannot be easily constituted (and reconstituted). The loss of guaranteed air superiority as it existed over Kosovo in 1999 may thus bring with it sizable strategic-level implications.⁴ The expeditionary footprint of the United Arab Emirates, and the difference the Turkish Bayraktar TB2 made on the battlefields of Azerbaijan (Second Nagorno-Karabakh War, 2020) and Ethiopia (blunting the Tigray march on the capital in the Winter of 2021-2022), demonstrate this point.

In a wider sense, the technology-cost asymmetry argument is felt in the cost exchange ratio when it comes to attacking versus defending weapons. The US Navy operating in the Gulf of Aden, where it tries to secure the Suez shipping route, provides an example of the most extreme disparity at present. Whereas an Iranian Shahed 136 costs around €40.000-80.000, an American Standard Missile-2 costs around €2.000.000 per intercepting missile.⁵ Technologically, it is just a lot more difficult and hence expensive to intercept a fast-moving target than it is to attack a stationary or slow-moving object, such as a supply dump or a vessel. In terms of sustainment, the quantity of these simpler and relatively much cheaper loitering munitions that can be produced matter too. In May and June of 2025, Russia managed to saturate parts of Ukraine’s integrated air defence by the sheer volume of Shaheds and decoys that it launched, increasing Russia’s hit rate from 5 per cent to 15 per cent.⁶

² See, on the proliferation of UAV technology beyond OECD countries, Sarah E. Kreps and James Patton Rogers, *Drones: What Everyone Needs to Know* (Oxford: Oxford University Press, 2025).

³ Robert Gilpin, *War & Change in World Politics* (Cambridge: Cambridge University Press, 1981).

⁴ On this second “offset” (against overwhelming advancing numbers of armour), see Thomas G. Mahnken, *Technology and the American Way of War Since 1945* (New York: Columbia University Press), chap. 5.

⁵ Estimate by Samuel Bendett of the Center for Naval Analyses in Dan Sabbagh, “The Shahed blitz: can Russian drone onslaught break Ukraine’s resolve?,” *The Guardian*, July 25, 2025, <https://www.theguardian.com/world/2025/jul/25/russia-record-attacks-ukraine-struggles-defend-itself>; James Black, “David vs. Goliath: Cost Asymmetry in Warfare,” *RAND*, March 6, 2025, <https://www.rand.org/pubs/commentary/2025/03/david-vs-goliath-cost-asymmetry-in-warfare.html>

⁶ Charles Clover and Christopher Miller, “Russia’s drone swarms pierce Ukraine’s defences at record rate,” *Financial Times*, July 21, 2025, <https://www.ft.com/content/1a19df67-3453-4a16-abf1-9fda36142f4b>

Proximate actors that harbour adverse intent that could heretofore muster no material threat, are now able to challenge European core interests.

What choices for the Royal Netherlands Army?

For European NATO, and thus the Netherlands, positional warfare on the Eastern flank based on attrition would be greatly augmented by a large fleet of UAVs that can neutralize an incoming attack. Such a multitude of simultaneous and sustained strikes would be at low cost and with no risk to troops that have to be in close contact with the enemy. Flooding the air littoral zone (below 3 kilometres) with a near-constant barrage will disorient and keep the enemy on the back foot, making it hard for them to mount a coherent and combined offensive: they simply cannot concentrate their forces. Small and cheap UAVs are now the superior way of both target discrimination (artificial intelligence is much better at distinguishing between combatants and non-combatants) and fire synchronization in time and space (the coordination of multiple weapons to maximize effect), and are hard for traditional air defences to take out at this low altitude. Elaborated below under option 3, this is the littoral air denial policy advanced in this brief.⁷

Simply put, the respective weight in the “iron triangle” consisting of firepower, protection, and mobility (as a result of the increased lethality of the first, the second and third have become increasingly difficult) has changed, and so must our force structure. To be sure, tailoring strategy and procurement to the next war is always fraught with uncertainties and unknowns. Moreover, especially insular organizations, like those in defence, typically stick with the certainties they know and the established practices that have worked well, improving, for instance, existing platforms. With the rapid technological adaptations in Ukraine, however, staying the course has become untenable both in terms of weapon effectiveness (vulnerability of the legacy platforms) and procurement route (too great a reliance on a few defence primes). Further, creating a UAV capacity as a force multiplier *next to* heavy legacy platforms bypasses current recruitment problems and, hopefully, the long procurement times with defence primes. By the time a legacy system comes online—often significantly over budget—they may not be based on the latest technology. The strategic need may also have changed. This route would follow the 20-40-40 “high-low” mix introduced in British Army doctrine: 20% traditional manned capabilities such as tanks and armoured fighting vehicles; 40% reusable platforms, such as the long-range piloted Predator UAV; and 40% attributable rockets, missiles, and loitering munitions.⁸

Based on function, range, technological complexity, and cost, three options are broadly speaking available:

Direct tactical option 1: Multi-rotor UAVs for ISR + self-propelled howitzers

This option corresponds with the dynamics on the battlefield in Ukraine from 2022 to the present. Due to the shortage of Western-delivered 155mm shells in mid-2024, Ukraine's emphasis had to shift to remote-controlled FPV hunter-killer UAVs. Today, they are responsible for around two-thirds of Russian armour and weapon systems damaged or

⁷ Kelly Grieco and Maximilian Bremer, “Contesting the Air Littoral,” *ÆTHER*, September 4, 2024, https://www.airuniversity.af.edu/Portals/10/AEtherJournal/Journals/Volume-3_Number-3/Grieco_and_Bremer.pdf

⁸ Ministry of Defence, “Strategic Defence Review,” June 2, 2025, p. 110, https://assets.publishing.service.gov.uk/media/683d89f181deb72cce2680a5/The_Strategic_Defence_Review_2025_-_Making_Britain_Safer_-_secure_at_home__strong_abroad.pdf

Creating a UAV capacity as a force multiplier next to heavy legacy platforms bypasses current recruitment problems.

destroyed.⁹ This edge does not mean, however, that artillery is no longer important: Ukrainian forces stress that it remains crucial for suppression fire.¹⁰ Traditional capabilities are not obsolete. Rather, they need to adapt in both design and how they are deployed, as in every war.¹¹ In Ukraine, remote-controlled quadcopters work in conjunction with artillery, providing, next to ISR, targeting information. In a way, the quadcopters function as the modern-day mounted scout, albeit with a more limited range of up to 15 kilometres from the pilot-operator. Costing north of €2000 per unit, a quadcopter could be in the backpack of every infantryman. Each would have to be well-trained with specially designed simulation video games.

Besides that, in this option, three hunter-killer UAV battalions are erected of each 600 men. Not all are operator-specialists. An independently operating crew has 6 to 8 soldiers who each have a different role, such as that of van driver-logistics provider, the perimeter guard and electronic warfare (EW) operator, the UAV launcher and explosives handler, etcetera. Ukraine's attacks on airfields deep inside Russia in Operation Spider's Web, and Israeli UAV units working inside Iran targeting ballistic missile launchers during the 12-day Israel-Iran War are examples of how effective such small, agile tactical units can be. Both occurred in June 2025. Principally aimed at defence (denial), blunting an attack, the units can also report to artillery stations on where and how best to attack entrenched, fortified positions.

Following the continued elemental function of artillery, as demonstrated in Ukraine, part of this option could be the acquisition of self-propelled howitzers, which would be part of a reconnaissance-strike system with quadcopters. Importantly, worst-case scenario – when satellites are not available or electronic jamming is heavy—the guns still work to stop advancing armour (that requires, though, that they have a parallel, fully analogue option). Procuring artillery would signal alliance commitment concerning NATO's demand for more Dutch heavy armour. Able to quickly disperse, this mobile protected firepower operates further in the rear in an indirect fire support role and is hence less vulnerable than an assault platform. The obvious downside when compared to a main battle tank is that mobile artillery cannot spearhead an assault to retake lost ground.

Typically, modern counter-battery radar can detect indirect fires up to 50 kilometres. The kill chain from fire detection to artillery returning fire can be as short as three minutes.¹² Hence, tactical mobility—how fast you can *shoot and scoot*—is key for the survivability of self-propelled howitzers. Towed artillery has become incredibly vulnerable.¹³ An example of a promising system is the Remote-Controlled Howitzer 155 millimetre (RCH 155), which puts the Panzerhaubitze 2000 gun that has great firepower and range onto a Boxer chassis for greater speed after firing to avoid counter-battery fire. The RCH also has a network-based architecture that can facilitate autonomous and remote-controlled functions in the future.¹⁴

⁹ Jack Watling and Nick Reynolds, "Tactical Developments During the Third Year of the Russo-Ukrainian War," *RUSI*, February 2025, p. 10, <https://www.rusi.org/explore-our-research/publications/special-resources/tactical-developments-during-third-year-russo-ukrainian-war>

¹⁰ Watling and Reynolds, "Tactical Developments," p. 11.

¹¹ See, for example, Azar Gat, "The Future of the Tank and the Land Battlefield," *Institute for National Security Studies*, July 20, 2023, <https://www.inss.org.il/publication/tanks/>

¹² Mykhaylo Zabrodskiy, Jack Watling, Oleksandr Danylyuk, and Nick Reynolds, "Preliminary Lessons in Conventional Warfighting from Russia's Invasion of Ukraine: February-July 2022," November 30, 2022, p. 38, <https://www.rusi.org/explore-our-research/publications/special-resources/preliminary-lessons-conventional-warfighting-russias-invasion-ukraine-february-july-2022>

¹³ Sam Skove, "The future is 'not bright' for towed artillery, Army general says," *Defense One*, March 27, 2024, <https://www.defenseone.com/threats/2024/03/future-not-bright-towed-artillery-army-general-says/395289/>

¹⁴ KNDS, "RCH 155 – One of the world's most advanced barreled artillery systems," <https://www.knds.de/en/systems-products/wheeled-vehicles/artillery/rch-155/>

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Currently, the Netherlands has only 33 self-propelled howitzers, with 22 operational.¹⁵ The proposal would be to procure 72 RCH 155s to form three extra battalions at an initial cost of €12 million per system.¹⁶

Indirect strategic option 2: The deep strike Lancet & the strategic Beaver

This second option pertains to a development from 2024 to the present and involves middle to long-range strikes far beyond the frontline. Instead of a number of smaller, temporary tactical wins on or near the frontline, this option seeks to attain strategic effect over a longer period of time. These systems only have an offensive, one-way function. Two systems that have a real-time video transmission link to a pilot-operator are worth pointing to as example systems. The €33,500 a unit Russian ZALA Lancet-3M, electrically powered with a two-blade propeller, is a loitering munition that flies at an altitude of between 500 meters and 5 kilometres at 100 kilometres per hour.¹⁷ The Lancet has a range of up to 50 kilometres and a payload of 2 to 3 kilograms.¹⁸ More technologically complex, and thus harder to source materials for and more costly to produce (and lose), its function is centred on air interdiction (deep air support) of ammunitions supplies traversing the lines of communication, impairing forward airstrips, and destroying artillery systems, radar and medium and long-range air defence launchers, and the command nodes directing fires and advances. Instead of directly attacking enemy forces, as in option 1, what is attacked is what the enemy needs to remain an operational fighting force, shaping the battle space for later direct penetration.¹⁹

The second system that is worth looking at is the long-range Ukrainian UJ-26 Beaver, costing around €110,000 per unit. It is equipped with a thermal camera and a jet engine, has a payload of 20 kilograms, and a range of 1000 kilometres.²⁰ It has an autonomous flight function once launched, with pre-programmed coordinates. Due to its speed, it is less a loitering munition than a missile, but with a fifteenth of the cost of a Tomahawk missile, which is technically much more complex. With its range, Moscow is within reach if launched from the Baltics. In contrast to the Lancet-type UAV, the Beaver is a weapon that is able to produce exhaustion—mentally (the population) and physically (the economy running aground)—and can in theory have strategic effect, depending on how far it is taken. They can be employed toward John Warden²¹ static targets that put pressure on social and commercial life in the long run. Examples of possible targets are vital infrastructure such as communication towers, oil refineries, and pipelines.

¹⁵ Koninklijke Landmacht, "Vuursteun Commando," <https://www.defensie.nl/organisatie/landmacht/eenheden/oocl/vuursteun-commando#:~:text=Nederland%20heeft%20in%20totaal%2033,Brigade%20en%2043%20Gemechaniseerde%20Brigade>.

¹⁶ Lisa West, "UK continues collaboration with Germany on new artillery," *UK Defence Journal*, August 2, 2024, <https://ukdefencejournal.org.uk/uk-continues-collaboration-with-germany-on-new-artillery/>

¹⁷ Max Hunder, "Cheap Russian drone a menace to Ukrainian troops and equipment," *Reuters*, June 28, 2023, <https://www.reuters.com/world/europe/cheap-russian-drone-menace-ukrainian-troops-equipment-2023-06-28/>

¹⁸ Quentin Sommerville, "Ukraine thrown into war's bleak future as drones open new battlefield," *BBC*, July 24, 2024, <https://www.bbc.com/news/articles/cne4vl9gy2wo>

¹⁹ On deep strikes of key military targets that are removed from the frontline, see Beatrice Heuser, *The Evolution of Strategy: Thinking War for Antiquity to the Present* (Cambridge: Cambridge University Press, 2010), 341.

²⁰ Kollen Post, "Ten Ukrainian drone makers to watch," *Kyiv Independent*, February 14, 2025, <https://kyivindependent.com/10-ukrainian-drone-makers-to-watch/>; S.I. Sutton, "Guide to Ukraine's Long Range Attack Drones," July 6, 2025, <http://www.hisutton.com/Ukraine-OWA-UAVs.html>

²¹ John A. Warden, "The Enemy as a System," *Airpower Journal* 9, no 1 (Spring 1995): p. 44ff.

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In Ukraine, it takes gaming talent and months of training and operational experience before an operator becomes an effective hunter-killer. A hunter-killer UAV with AI allows many more soldiers to use it with effect.

AI-powered option 3: The Anduril option

This option reflects current military affairs: only in 2025 did AI-powered UAVs really kick off in Ukraine. The system to take as an example to follow is the Bolt-M loitering munition from the American firm Anduril. It has a range of 20 kilometres, can take off *and land* vertically (if it returns within its 40 minutes of flight time), has a payload of up to 1.35 kilograms, and costs in the “low tens of thousands of dollars” depending on the configuration.²² The cost will go down when this man-portable precision strike capability is procured in mass (in case of a high-intensity conflict). More a large type of missile, the AI-driven HX-2 from the German Helsing is comparable to the Russian Lancet, costing around €30.000 but with a range of 100 kilometres.²³ While the Lancet has some AI guidance, such as automated target recognition, the Bolt-M platform has automated flight and navigation as well as the automated finding, tracking, and striking of targets that machine learning has taught it to pursue. It is not fully AI-guided, however, as it keeps the human in control of key decision phases. Equipped with a touchscreen, it instead simplifies flight control and the OODA (observing, orienting, deciding, and acting) loop, reducing the level of skill required by the individual operators. In Ukraine, it takes gaming talent and months of training and operational experience before an operator becomes an effective hunter-killer. A hunter-killer UAV (of option 1) *with AI* thus allows many more soldiers to use it with effect. As described above, due to its limited range, the main purpose of the hunter-killer UAV for the defending NATO alliance is to stop an armoured attack by Russia (denial).

Adopting proposed option 3 would, first, remove much of the vulnerability of the 6 to 8-man crew. Bound by the limited range of the UAVs they operate, they have to position themselves near the frontline. These fully manually-operated drone units transmit radio frequency signals throughout the OODA loop; signals that can be picked up by enemy sensors, opening the crew up to a kinetic strike. Second, in option 3, the main vulnerability in attack that contemporary remote-controlled UAVs have is resolved: the pilot-operator needing to maintain a space-connected link with the UAV at all times. One can think of Ukraine's dependence on Elon Musk's Starlink. Furthermore, in highly contested environments, the adversary can use constantly evolving electromagnetic signals to jam the UAV's ability to navigate and receive commands, resulting in the loss of the UAV. In Ukraine, now 200 out of 800 defence companies work to constantly innovate EW.²⁴ After the initial phase of the war, when the frontline has stabilized and industry has matured, EW defences will have become “more numerous and more sophisticated,” with frequency gaps in the electromagnetic spectrum needed to maintain the signal with the attacking UVA becoming “increasingly rare.” This reminds us of the surfaces versus gaps probing in manoeuvre warfare.²⁵ A much-used anti-UAV system in Ukraine is the limited-range tactical EW shield of approximately 50 meters. By contrast, UAVs that use automated navigation and target recognition make a hit three to four times more likely.²⁶ An alternative option to counter EW that is currently available is the

²² Michael Marrow, “Anduril debuts new ‘Bolt’ quadcopter for sensing, strike missions,” *Breaking Defense*, October 10, 2024, https://breakingdefense.com/2024/10/anduril-debuts-new-bolt-quadcopter-for-sensing-strike-missions/?utm_source=chatgpt.com; Anduril, “Anduril Unveils Bolt and Bolt-M,” October 10, 2024, <https://www.anduril.com/article/anduril-unveils-bolt-and-bolt-m/>

²³ The Economist, “Could a German startup disrupt Europe's arms industry?,” February 13, 2025, https://www.economist.com/business/2025/02/13/could-a-german-startup-disrupt-europes-arms-industry?utm_source=chatgpt.com

²⁴ The Economist, “Fighting the war in Ukraine on the electromagnetic spectrum,” February 5, 2025, <https://www.economist.com/science-and-technology/2025/02/05/fighting-the-war-in-ukraine-on-the-electromagnetic-spectrum>

²⁵ U.S. Marine Corps, “Warfighting,” June 1997, p. 92, <https://www.marines.mil/portals/1/publications/mcdp%201%20warfighting.pdf>

²⁶ Kateryna Bondar, “Ukraine's Future Vision and Current Capabilities for Waging AI-enabled Autonomous Warfare,” *CSIS*, March 2025, 2, <https://www.csis.org/analysis/ukraines-future-vision-and-current-capabilities-waging-ai-enabled-autonomous-warfare>

fibre-optic-guided UAV, such as the HCX made by HIGHCAT. Yet, the fibre cannot unspool indefinitely and can break. This UAV can also not be deployed in a swarm formation, as the wires can get entangled. A well-trained pilot-operator per UAV is also still needed.²⁷

Invest in industry, not pre-war mass

If the Netherlands adopts option 3, which is proposed, it should focus on industry instead of already produced mass. In this way, not only is a final (politically sensitive) decision to acquire this capacity in full postponed beyond testing and training with small numbers, but rapid scaling up is possible according to the most up-to-date software and hardware innovations. In Ukraine, there is a constant innovation-counter-innovation game taking place in basements, small labs, and trenches between UAVs and anti-UAV systems. For instance, Ukraine has developed the Ptashka counter-UAV that approaches an incoming enemy UAV from above, neutralizing it by shooting downward a net. Mostly, though, the adaptations occur through software updates. In Ukraine, a major innovation takes place every 8 to 12 weeks.²⁸

Access to American weapons and industry now a matter of certain uncertainty, expanding drastically the Dutch defence industry is the imperative. In fact, having a mature industrial base with the ability to scale up rapidly can in itself have a deterrent effect: adversaries would know that European NATO can sustain a protracted fight (compared to the weeks or months Europe can hold out today). Below are spelled out some of the concrete suggestions to forge an industrial base involving a Dutch company like startup Intelic (formerly Avalor AI).

The industrial plan would require:

- A Center of Future of War Transformations that has top-level buy-in from and access to the Commander of the Armed Forces and is headed by a high-ranking military official.
- Adopt the Scranton Army Ammunition Plant model, where the factory space and production lines are government-owned. Located around Brainport Eindhoven, this would facilitate a rapid scaling up from an existing manufacturing base.
- Be centred on bottom-up collaborative innovation, as typically occurs during wartime; this has proven the superior model in Ukraine, given quick battlefield adaptations.²⁹ Because it is hard to emulate during peacetime, studying future conflicts abroad will generate much of the innovation.
- Have military technology engineers from organisations such as TNO and Thales Netherlands (for the whole product design and the explosives part), chip design and manufacturer engineers from, for example, NXP (for the automated target recognition chips) and video camera engineers from, for instance, Teledyne Adimec (for the 70-millimeter camera) working in the same space as UAV operator-specialists (with direct lines to the units that would be deployed to the frontline), 3D-printing manufacturers for the carbon fibre airframe, propeller, and other components, sourcing and logistics managers, and tech start-up entrepreneurs with access to private financiers (as in the Silicon Valley ecosystem).

²⁷ David Hambling, "Jam-Proof Fiber Optic Drone Testing in Ukraine," *Forbes*, August 2, 2024, <https://www.forbes.com/sites/davidhambling/2024/08/02/german-jam-proof-fiber-optic-drone-testing-in-ukraine/>

²⁸ The Economist, "Fighting the war."

²⁹ Kerry Chávez and Ori Swed, "Emulating underdogs: Tactical drones in the Russia-Ukraine War," *Contemporary Security Policy* 40, no. 4 (2023): p. 599ff.

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