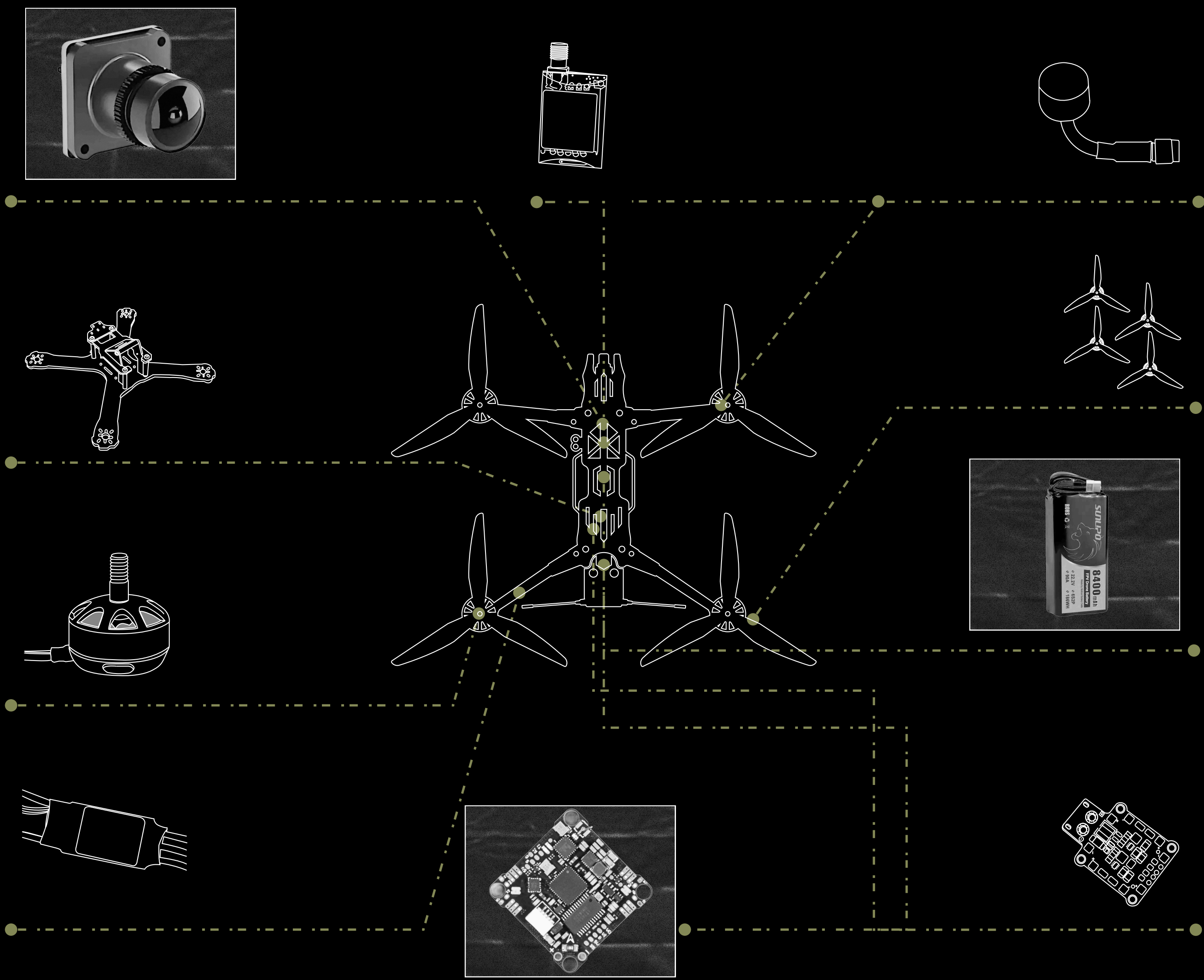
Building the ARSENAL



SECURING THE COMPONENTS
TO SUSTAIN COMBAT POWER

Editor's Notes

Catarina Buchatskiy

Director of Analytics, Snake Island Institute

This report examines a paradox in Ukraine's domestic defense production. Ukraine, without a doubt, has built something extraordinary — a drone industry that scaled from a handful of manufacturers in 2022 to hundreds of companies delivering hundreds of thousands of systems monthly. But the picture that emerges is one of resilience under pressure but not independence. Unfortunately, beneath that success, our industrial foundations remain fragile, for we have built on foundations that can be swept away with a signature on an export license in Beijing.

We are masters at assembling drones in Ukraine now — frames cut in Kyiv workshops, flight controllers flashed with Ukrainian firmware. But the lithium in our batteries, the neodymium in our motors, the chips that process our targeting data — these still cross borders controlled by nations who do not wish the West to win and who will actively work to prevent it.

Every Chinese export restriction since 2022 has reverberated directly onto the battlefield. We have watched prices triple overnight, seen production lines stall for want of components that cost pennies but are controlled by supply chains spanning continents. We have built resilience through sheer determination, but resilience built on improvisation is temporary. What happens when the grey markets dry up? When the volunteer networks can no longer bridge the gaps? When Beijing decides that even indirect sales are too much support for Ukraine?

For our allies, Ukraine's supply chain dependencies are not just our problem, but a preview of NATO's own strategic exposure. The same magnets we cannot secure, the same lithium chemistries we cannot replace, the same optical components we import under duress are embedded across Western defense programs. If China can constrain Ukraine today, it can coerce the Alliance tomorrow.

Despite these vulnerabilities, Ukraine has built a defense industry producing at wartime scale on NATO's border—one that can manufacture millions of systems annually even while navigating hostile supply chains. These dependencies are solvable with allied support, but the production infrastructure, combat-tested designs, and manufacturing expertise already exist. The choice before our allies is whether to invest in securing Ukraine's supply chains or spend years and billions building equivalent capacity from scratch.

Ihor Fedirko

CEO of Ukrainian Council of Defence Industry

Since the beginning of the full-scale invasion, Ukrainian arms and military equipment manufacturers have demonstrated unprecedented progress in developing advanced technologies to counter the aggressor. Today, however, as we consider the future growth and scaling of the defense technology sector, localization has become a critical priority.

This study highlights both the progress already made in localization and the structural barriers that persist. Survey findings show that Ukrainian defense producers are united in their determination to localize production and reduce vulnerabilities stemming from foreign supply chains. The imperative of minimizing dependence on Chinese inputs is broadly recognized across the industry.

The achievements to date are significant. In the UAV sector, nearly all components of final systems are already localized in Ukraine. Yet, much of this localization still takes the form of large-node assembly, relying on imported raw materials and components. Domestic production of SMD components is entirely absent, while printed circuit board (PCB) manufacturing exists but remains limited in capacity and lacks advanced technologies. Critical feedstocks — carbon fiber, fiberglass, optical fiber, aluminum — as well as magnets for permanent-current motors are not produced at industrial scale in Ukraine. This leaves even localized assembly dependent on imports, a substantial portion of which continue to come from China.

The outlook, however, is dynamic. With sufficient investment, Ukraine has the capacity to expand beyond assembly into domestic production of raw materials and key components, strengthening the entire supply base. Combined with the coordinated efforts of the Ukrainian Council of Defense Industry and closer collaboration with international partners, such development would not only deepen localization but also enhance supply chain resilience.

For allied policymakers, the message is clear: Ukraine's defense industry has made remarkable strides in localization under wartime conditions, but the next phase — building a raw-material and component base — requires targeted support. Sustained co-production, industrial investment, and technology partnerships are essential to transform resilience into true independence.
Our manufacturers and military defend our nation's right to independence. Yet Ukrainian weapons and expertise can also serve as a bulwark for the entire civilized world against autocracy. It is our shared duty to do everything possible to make this a reality.

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Methodology

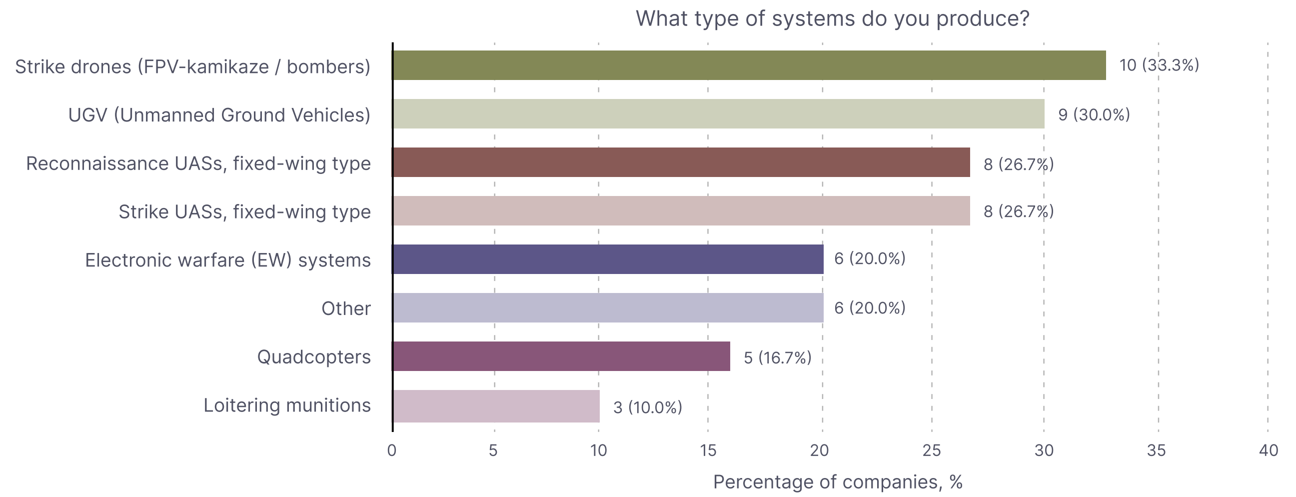
This report is based on a mixed-methods research design combining direct polling, structured interviews, and open-source intelligence (OSINT). In coordination with the Ukrainian Council of Defence Industry (UCDI), researchers directly engaged 30 manufacturers to gather baseline data on sourcing practices, production volumes, and supply chain vulnerabilities. Rather than distributing written surveys, these polls were conducted through direct communication, allowing clarification of responses and targeted follow-up on sensitive issues.

In addition, the research team carried out 13 structured, hour-long interviews with leading manufacturers and stakeholders across the drone and defense technology sector. These conversations provided detailed qualitative insights into how firms adapt to component shortages, navigate export restrictions, and plan for scaling production.

While this sample represents a fraction of the ecosystem, it includes firms across different specializations — assemblers of FPV, bombers, ground robotic complexes, wing-type strike and reconnaissance drones, electronic warfare developments, and others.

To complement this primary research, the team employed OSINT methods to collect and analyze customs records, trade data, market pricing trends, and technical reporting on UAS (unmanned aircraft system) components. This enabled validation of industry claims and added quantitative depth to the qualitative findings.

Surveyed manufactures by type of systems produced



Introduction

Ukraine's wartime unmanned systems boom has transformed a once-nascent drone industry into a critical pillar of national defense. Under the pressures of full-scale war, Ukraine expanded from only a handful of producers to hundreds of manufacturers turning out millions of different types of drones annually. This rapid growth – fueled by improvised solutions, volunteer efforts, and streamlined procurement – has given Ukraine's military a drone fleet almost unmatched in scale globally. However, this success relies on complex supply chains that remain vulnerable; Chinese-made components have historically dominated Ukraine's drones, creating a strategic dependency that Beijing's recent export restrictions have exposed. Meanwhile, Ukraine's push for domestic production of key parts (from frames to flight controllers and motors) is gaining momentum, but critical gaps persist – especially in microelectronics, batteries, and other high-tech inputs.

This report analyzes the evolution of Ukraine's sourcing under wartime conditions, maps out component-level supply chains (domestic and foreign), and assesses external dependencies – particularly on China – along with emerging threats and strategic risks.

Ukraine's First Deputy Minister of Defense Ivan Havryliuk cited that Ukraine produces up to 200,000 FPVs monthly and must continuously replenish its fleet, making supply chain resilience a matter of survival. [1] According to Defense Minister Denys Shmyhal, Ukraine needs to produce 400,000 unmanned systems per month in order to compete with Russia. [2] Chinese civilian drone bans since 2022 have raised costs and slowed production, forcing Ukraine to seek workarounds at triple the price for some components. At the same time, Russia's own drone program benefits from shadow Chinese supply, eroding Ukraine's earlier drone advantage. Ukraine's domestic drone industry – now reportedly capable of up to 10 million drones per year – can become a long-term strategic asset for both Ukraine and its allies, but only if its supply chains are secured. [3]

Ukraine has built a wartime production base unmatched in speed and scale: millions of drones assembled each year, with frames, avionics, radios, and even cameras increasingly localized. Yet the industry still depends on a narrow set of critical imports — lithium salts, neodymium magnets, navigation chips, and thermal sensors — where China holds disproportionate leverage. Each new export restriction has translated into higher costs, delayed deliveries, and battlefield risk. **The lesson is not that Ukraine's drone industry is fragile, but that its success has outpaced the supply chains that feed it.** If allies help close these specific gaps — through targeted investment in batteries, magnets, and optics, and by embedding Ukrainian firms into NATO's procurement ecosystem — Ukraine can evolve into a powerful long-term arsenal for the democratic world.

September

2025

1. Korshak, S. (2025, February 10). Ukraine drone production tops 2.5 million a year, aircraft numbers on track to grow. Kyiv Post. kyivpost.com
2. https://newsukraine.rbc.ua/news/ukraine-must-produce-400-000-drones-monthly-1757597170.html
3. Kesteloo, H. (2025, July 24). Exposed: Beijing's Secret Drone Parts Arming Russia Despite US-EU Bans. DroneXL.co. https://dronexl.co

Early Stages: Emergency Reliance on Imports (2022)

Before the full-scale invasion, Ukraine had only a small fleet of military-grade UAVs in service. On the strike side, the Armed Forces operated roughly a dozen Bayraktar TB2 UCAVs by late-2021 (Air Force + Navy)—with Ukraine's commander-in-chief publicly saying "12 TB2s are in inventory" and a plan to buy 24 more [4]. On the reconnaissance side, several Ukrainian-made short-range systems had been adopted in modest quantities since 2015–2020: Spectator-M1 (Meridian), with ~72 airframes introduced to the Air Force by 2016 and "over 60" in AFU/Border Guard by 2019; A1-CM/A1-SM Furia (Athlon Avia), with 100+ complexes delivered by end-2021; and Leleka-100 (DeViRo), approved for AFU service in 2021 after years of field use in Donbas. [5] Drones were already being actively developed in Ukraine, but until the outbreak of large-scale war, there was no need for them on such a massive scale, and most demand was covered by modest domestic production and volunteer-procured COTS units.

At the outset of Russia's full-scale invasion, Ukrainian forces fielded drones that were overwhelmingly dependent on commercial off-the-shelf (COTS) imports, especially from China. In 2022, 97% of imported UAS came from China, according to customs data [6]. Given that the estimated Ukrainian production was 3,000-5,000 units in 2022 with a total import of 530,000 units, as many as 99% of drones produced and imported in 2022 appear to have been Chinese-made. [7] Aerial reconnaissance and strike units leaned heavily on Chinese DJI quadcopters (MAVICs held 76% of the world drone market as of March 2021) and generic Chinese motors, batteries, and controllers [8]. These systems were inexpensive, immediately available through civilian markets, and could be adapted for frontline use with minimal delay. They provided urgently needed aerial reconnaissance and strike capacity but carried embedded vulnerabilities: reliance on foreign GPS modules, imported batteries with limited cold-weather resilience, and video links easily disrupted by Russian electronic warfare (EW).

This dependence extended beyond the air domain. Naval drones, including early prototypes of the Magura V5, relied on imported navigation modules, commercial engines, and Starlink terminals for connectivity, while unmanned ground vehicles (UGVs used for logistics and casualty evacuation) employed adapted radio-control modules and imported optics.

All three systems shared the same critical weakness: a heavy reliance on Chinese-made electronics and navigation systems, making Ukraine vulnerable to sudden disruptions. DJI's suspension of direct sales of quadrocopters to both Ukraine and Russia in April 2022 highlighted this fragility, forcing Ukrainian units into grey-market purchases and improvised sourcing routes. The effect was visible in prices: aggregated data from volunteer fundraisers show that a DJI Mavic 3 initially cost around $2600, but by mid-2022, after DJI's suspension, the price had risen to $2900. Dependence on Chinese systems translated not only into logistical risk but also into a steep cost burden for sustaining frontline drone fleets.

Western suppliers were initially ill-suited to fill this gap. Export controls, International Traffic in Arms Regulations (ITAR) restrictions, and licensing timelines meant that precision optics, high-end navigation kits, and encrypted radios were effectively inaccessible for supporting the Ukrainian war effort in 2022. More specifically, although the U.S. Directorate of Defense Trade Controls declared that it would prioritize Ukrainian cases involving ITAR-regulated goods, it gave no guarantee of shortening the review process, which

4. Daily Sabah. (2021, September 12). Ukraine to buy 24 more Turkish Bayraktar TB2 UCAVs. Daily Sabah. https://www.dailysabah.com
5. Aeronaut Media. (2024, July 24). Best Ukrainian UAVs: Part 1. https://aeronaut.media
6. State Statistics Service of Ukraine. (2022). Archive of freight transport volume index data. https://www.ukrstat.gov.ua
7. Bilousova, O., Omelchenko, E., Makarchuk, M., & Mylovanov, T. (2024, October 4). Ukraine's Drones Industry: Investments and Product Innovations. Kyiv School of Economics. https://kse.ua
8. Hawkins, L. E. (2023, February 24). What to Know About the Growing Drone Market. Nasdaq. https://www.nasdaq.com

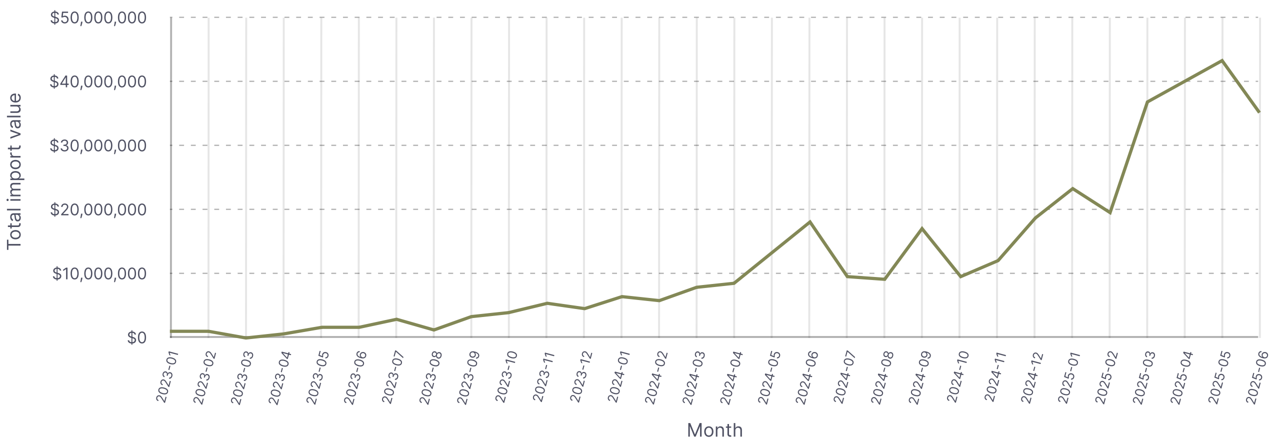
typically lasts 40–45 days [9]. In addition, many European and American defense companies, such as British Supacat, Spanish Navantia, American Insitu, HII, Teledyne FLIR, blocked access to their websites from Ukraine, citing international regulatory requirements as the reason. [10] The lack of pre-war integration with NATO supply chains compounded delays in substituting Chinese parts.

Even as domestic assembly expanded, every shock in Chinese supply reverberated directly onto the battlefield: procurement speed without secure inputs builds capability that can vanish overnight.

Transition Phase: Policy Incentives and Local Prototyping (2023)

By mid-2023, Kyiv moved to reshape the sourcing picture. Parliament waived Value Added Tax (VAT) and customs duties on imported drones and components. For Ukrainian manufacturers, this meant paying only what foreign suppliers charged for components, without the burden of additional taxes or customs fees [11]. From small volunteer teams without significant external funding that characterized 2022, the sector started to transform in 2023, with defense startups attracting nearly $5 million in private investment [12]. While angel investors played the main role initially, this period also marked the entry of venture capital firms into Ukraine's defense tech sector. Ukrainian funds, such as Ukrainian Startup Fund, Nezlamni by Uklon, Radius Capital, Green Flag Ventures, D3, 42CAP, u.ventures, and SMRK have begun to play a larger role, signaling a shift toward more institutionalized financing. Simultaneously, starting in mid-2023, governmental programs such as Army of Drones and BRAVE1 channeled funds to startups and integrators, accelerating the cycle from

Figure 2: Monthly import value of UAS components (Source: State Statistics Service of Ukraine).



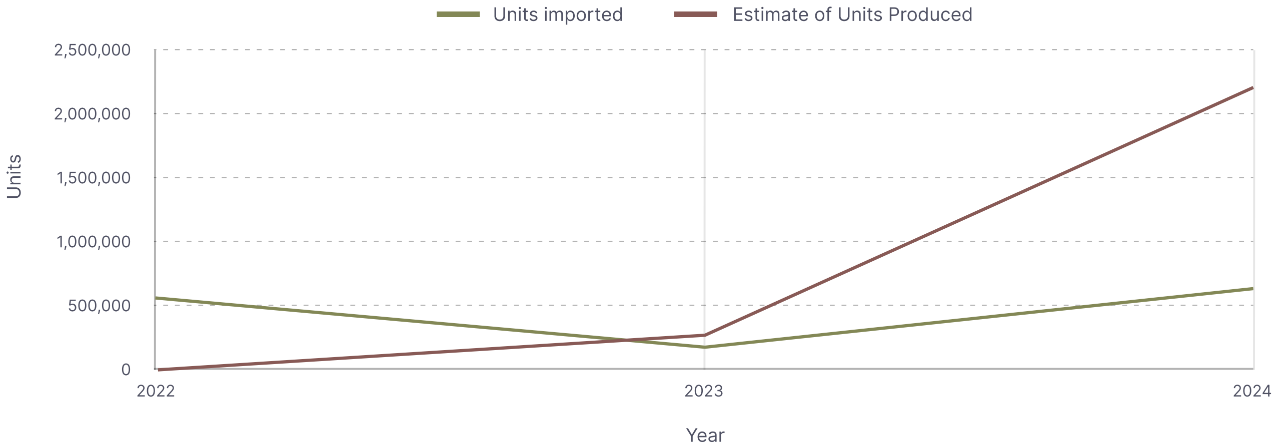
9. DDTC. (n.d.). DDTC publishes clarification on expedited registration requirement for Ukraine exports. WorldECR. www.worldecr.com
10. Malyasov, D. (2025, February 5). Western defense firms block website access for Ukraine. Defence Blog. defence-blog.com
12. Kozatskyi, S. (2023, June 20). Зеленський підписав закони про підтримку виробництва дронів в Україні [Zelensky signed laws to support drone production in Ukraine]. Militarnyi. /militarnyi.com

concept to prototype and combat trial to a matter of weeks. By the end of 2023, BRAVE1 had distributed 135 grants totaling $2.3 million, including 24 grants specifically awarded to unmanned systems startups. [13] UAS component imports increased substantially – by almost 350% – from $3.2 million in the first half of 2023 to $14.4 million in the second half (see Fig. 2). As a result, the number of drones produced domestically surpassed imported systems in 2023, starting a trend of steadily widening domestic dominance in subsequent periods (see Fig. 3).

Another key development in 2023 was the ability for individual brigades to purchase drones directly using local funding mechanisms. Cities where military units were registered could return between 10% and 100% of locally collected personal income tax to these units. These funds were then used to procure drones from the same manufacturers supplying defense startups and brigades, creating a powerful scaling effect in drone deployment. Additionally, municipalities themselves separately procured and supplied drones to military units, further accelerating usage across the front. The combined effect of local tax redistribution and municipal procurement amounted to hundreds of billions of hryvnias in total funding. Collectively, this mechanism brought a large amount of money into the drone industry, allowing the manufacturer to significantly scale and develop its products. But this decentralized funding process was discontinued in late 2023 – early 2024, when personal income tax revenues were redirected to the central budget by government decision, effectively removing a significant channel that had enabled brigades to self-finance drone purchases. [14]

Overall, for aerial drones, this translated into early domestic assembly of frames and controllers, with limited but growing substitution of Chinese optics by locally integrated thermal cores. Maritime systems benefited from government-backed R&D grants that enabled partial substitution of imported hull and propulsion elements with Ukrainian engineering. Later versions of the MAGURA and Sea Baby drones had housings from a domestic manufacturer. BRAVE1 brought sea programs into scope, including the newly modified Toloka TLK-150 kamikadze drone. [15] In turn, the most renowned USVs (MAGURA V5, Sea Baby) are consistently described as Ukrainian-designed platforms, with domestic teams leading the hull design and integration. On land, ground drones now field Ukrainian-built chassis but still depend on foreign radio-control systems. Despite accelerating localization,

Figure 3: Annual drone imports and domestic production by year, 2022-2024 (Sources: State Statistics Service of Ukraine; KSE Institute).

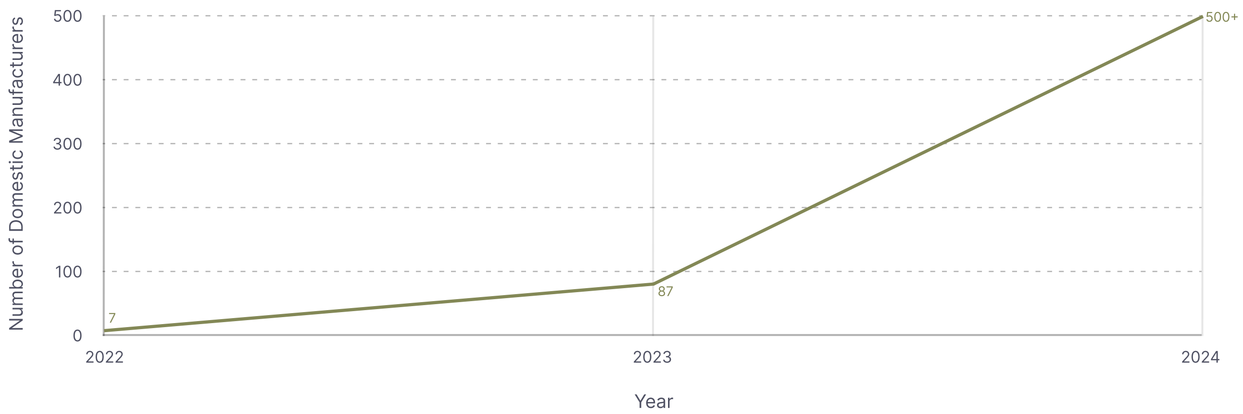


13. Dziuba, O. (2023, December 22). Кластер оборонних технологій Brave1 профінансував 135 розробок на $2,3 млн. Яких технологій найбільше [Brave1 defense technology cluster funded 135 developments worth $2.3 million: Which technologies dominate]. Dev.ua. dev.ua/news/
14. LigaZakon. (2023, November 8). Військовий ПДФО буде спрямовано на армію: закон прийнято. https://biz.ligazakon.net
15. Defense Express (n.d.). Ukraine shows its underwater kamikaze drone: Improved TLK-150 revealed. en.defence-ua.com

production across these domains still relies heavily on imported electronics for guidance, communications, and payloads. 16

A defining feature of this period was procurement at the municipal and brigade level with decentralized prototyping: dozens of micro-workshops and small and medium-sized enterprises emerged that produced flight controllers, wire harnesses, and small-batch airspeed regulators and could sell these directly to brigades. Informal standards developed as advanced units met requirements. Influx of money from the military and direct communication allowed drones to meet modern needs, shortening adaptation cycles in a way that Western industrial suppliers could not match.

Figure 4: Estimated number of domestic manufacturers by year, 2022-2024.



Consolidation: Domestic Assembly, Persistent Import Dependence (2024-2025)

By late-2024, Ukrainian integration capacity had scaled dramatically. The Ministry of Defense reported that 95% of UAS supplied in 2024 were assembled domestically 17. The total value of components imported in 2024 surged by 670% compared to 2023 (see Fig. 5). In contrast, the value of fully assembled drone imports grew by only 82% over the same period. Imports of complete systems dropped sharply in mid-2024 and had essentially stopped growing by mid-2025 (see Fig. 6). Still, customs data for Jan–May 2024 showed that 88.9% of UAS component imports by value came from China. This duality was visible across domains:

- **FPVs:** domestically assembled frames and battery packs, but reliant on imported motors, battery cells, Global Navigation Satellite System (GNSS) modules, and other microelectronics.
- **Maritime drones:** hull fabrication and payload assembly localized, yet engines, navigation systems, and some EO sensors imported.
- **Ground drones (UGVs):** Ukrainian workshops produced airframes and armor shells, but high-torque motors and durable comms remained foreign sourced.

16. Post, K. (2025, August 15). "Little by little away from China" — Inside Ukraine's new mass-production of drone parts. The Kyiv Independent. kyivindependent.com
17. Pashko, V., & Svyrydiuk, Y. (2023, July 21). Умєров: 95% дронів, які використовують на фронті — зроблені в Україні [Umerov: 95% of drones used at the front are made in Ukraine]. Suspilne. suspilne.media

The policy leaves room for improvement. While the 2023 parliamentary bill allows finished components to enter Ukraine duty- and VAT-free, raw materials and sub-components required for domestic production remain subject to VAT (e.g., motor magnets or receiver elements). This creates a cost imbalance: importing ready-made Chinese components is cheaper than sourcing raw inputs and assembling them locally. As a result, domestic manufacturers face a structural disadvantage, discouraging deeper value-added production inside Ukraine.

Thus, by 2024, Ukraine had achieved impressive assembly sovereignty but not component sovereignty.

Figure 5: Annual import value of UAS components, 2022-2024 (Source: State Statistics Service of Ukraine).

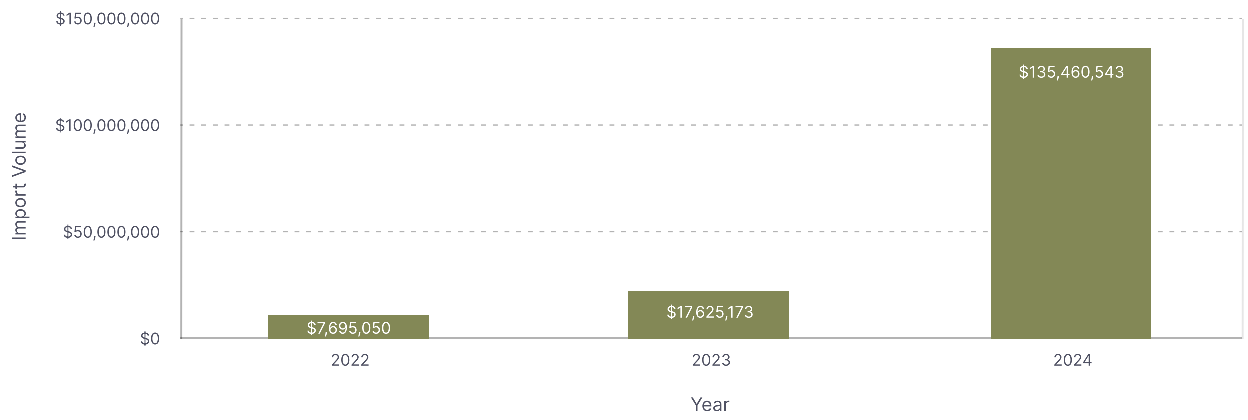
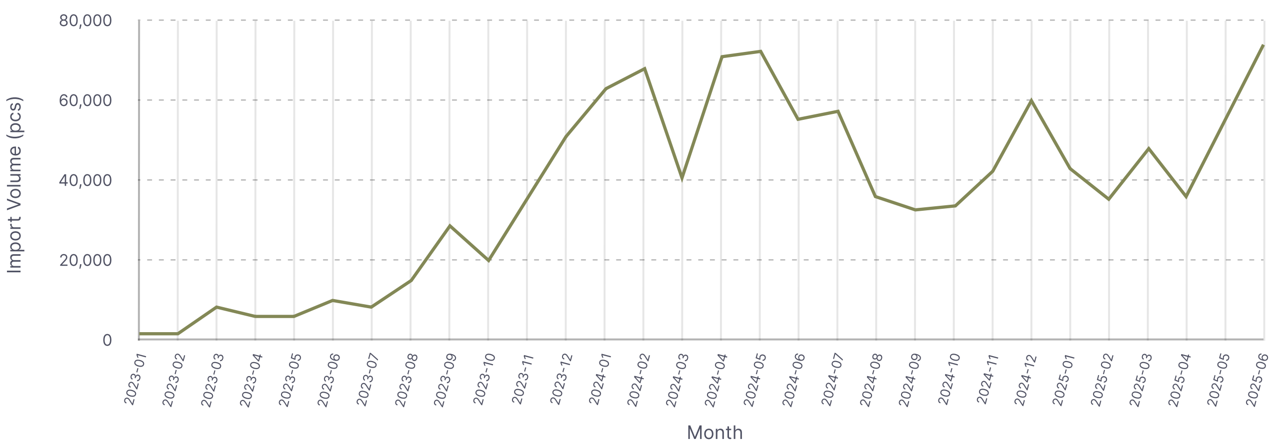


Figure 6: Monthly import volume of fully assembled UAS (Source: State Statistics Service of Ukraine).

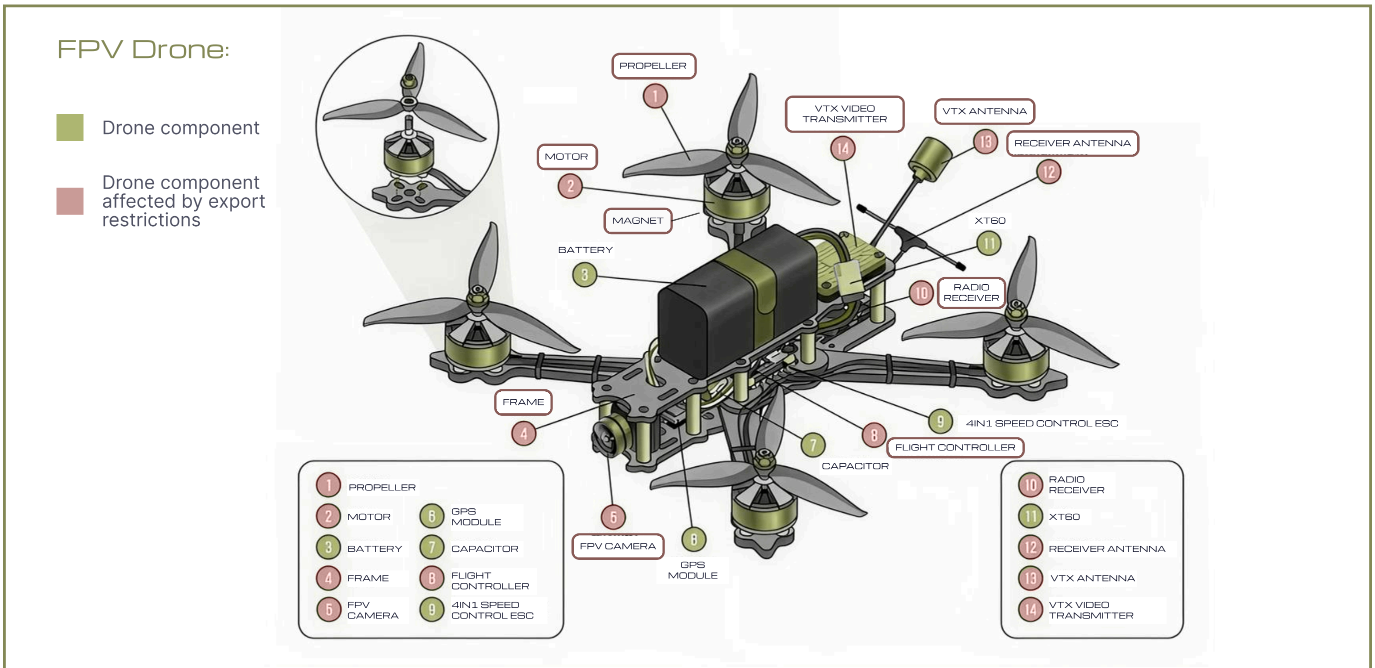


Chinese export restrictions

China's role in Ukraine's UAS supply chain looms large. China is the world's dominant producer of small drones and drone parts, and this dominance has translated into leverage – both economic and geopolitical – over Ukraine's drone program. In the low-cost drone market, Chinese companies (led by DJI) have for years supplied the bulk of global demand. China produces around 75% of the world's drones, with the majority not for military purposes. [18] For Ukraine, this meant that at the full scale invasion's outset, Chinese-manufactured drones were essentially the backbone of its aerial ISR (intelligence, surveillance, reconnaissance) and light strike capability. In 2023, Kyiv reportedly purchased 60% of DJI's entire global production of Mavic drones – a staggering figure that underscores both Ukraine's dependence and the scale of its drone usage. Additionally, China leads in producing many drone components (lithium batteries, hobby flight controllers, etc.), making it hard for any country to avoid Chinese parts.

During the war, the Chinese Ministry of Commerce (MOFCOM) introduced several rounds of export restrictions on drones and related components.

The first wave of government restrictions came in June 2023, China banned exports of long-range (>7 kg) drones to both Russia and Ukraine. Then in September 2023, when China required export licenses for a wide range of drone-related items, including UAV engines, infrared imaging devices, synthetic aperture radar, target-designating lasers, radio communication equipment, and even civilian anti-UAV systems [19]. In December 2023, controls were extended to lidar systems used in the production of communication and electronic equipment [20]. Then on September 1, 2024, China imposed export restrictions on a wide range of drone parts – including flight control systems, drone frames, motors, radio modules, and cameras – effectively cutting off the supply of these items to Ukraine (and ostensibly to Russia as well). While China claimed it wanted to prevent use of its drones in warfare, the move was widely seen as asymmetrically impacting Ukraine. Evidence suggests that Chinese entities have continued to supply Russia via indirect channels, even as Ukraine's legitimate purchases were throttled. [21]



https://www.shutterstock.com/image-vector/fpv-drone-components-isometric-isolated-on-2540264905

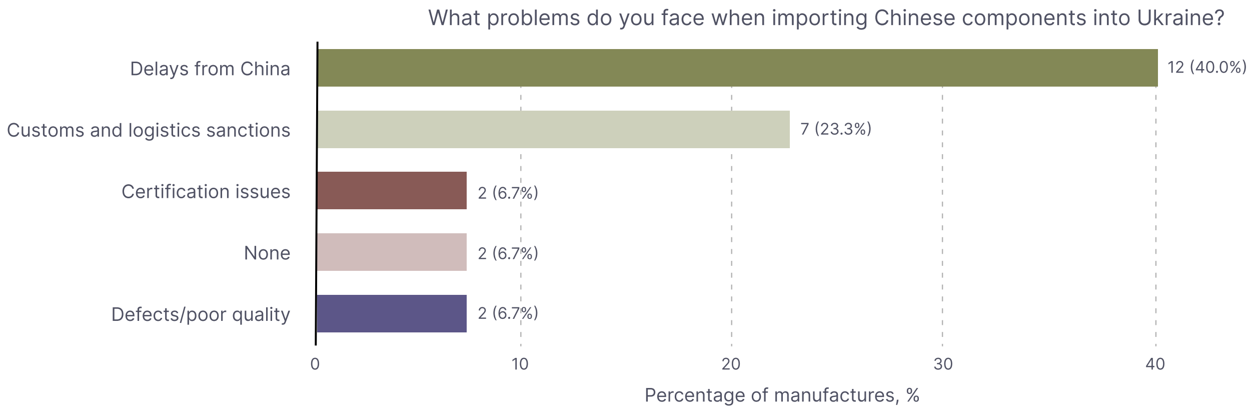
18. Reuters. (2025, July 23). Exclusive: Chinese engines, shipped as 'cooling units', power Russian drones used in Ukraine. Reuters. www.reuters.com
19. Government of China. (n.d.). China: Government announces export control measures for 30 drone-related items.Global Trade Alert. globaltradealert.org
20. Government of China. (n.d.). China: Government releases revised catalogue containing technologies banned or restricted from export. Global Trade Alert. globaltradealert.org
21. Government of China. (n.d.). China: Government adds one item to list of drone-related items under export control.Global Trade Alert. globaltradealert.org

SII and UCDI's survey data from Ukrainian producers confirms the impact of these measures: 40% of manufacturers reported delays in deliveries from China. This underlines how regulatory tightening in Beijing translated directly into disruptions in Ukrainian supply chains, forcing companies to deal with longer lead times, unpredictable shipping conditions, and in some cases stalled production cycles.

Nearly a quarter (23.3%) pointed to customs and logistical sanctions. A few firms reported certification issues and poor quality. These findings illustrate how regulatory tightening translated into practical bottlenecks: longer delivery times, added uncertainty in logistics, and new compliance hurdles that collectively disrupted production cycles.

Several extended responses from producers highlight these dynamics more clearly. One company noted that since September, they have been expecting problems with ordering "almost everything," from chips, controllers, and other finished electronics for drones. Another reported that there is almost no delay from China itself, but some of their colleagues in the market claim that certain production lines put them in a queue because of large Russian orders. At the same time, a minority of respondents stressed that they managed to mitigate risks through direct partnerships, with one stating that they have a friendly factory in China.

Figure 7: Problems faced by manufacturers when importing from China.



Russia's Industrial Advantage: Financing, Acquisition, and Scale

Despite Chinese restrictions, enforcement has remained inconsistent. Both Ukraine and Russia continue to acquire drone components, with Russia doing so on an industrial scale. China has been maintaining a substantial, though covert, supply chain with Russian drone-producers despite sanctions. Between 2023 and 2024, Chinese firms are reported to have exported at least $67 million worth of parts and materials to Russian companies under sanctions for drone production.

Nearly one-quarter of that value, around $14.5 million, went to companies involved in producing Iranian-style kamikaze drones (e.g. Shahed) operating in the Alabuga special economic zone in Russia. The exports include a range of dual-use and specialized components: aircraft engines, microchips, metal alloys, camera lenses, carbon fibre yarns and binders, fiberglass and related materials — elements essential to drone airframes, propulsion, guidance, or payload systems. Ninety-seven different Chinese suppliers provided these materials. [22]

The Alabuga zone seems to be a key node for Russia's drone production: aside from producing Shahed clones, it is part of Russia's broader push to build large-scale domestic drone manufacturing capacity. The volume and variety of supplies from China indicate that sanctions and export controls have so far failed to fully block the flow of critical parts into Russia's industrial drone ecosystem.

Additionally, Russian firms are gaining a strategic upper hand in securing drone components by using their financial muscle to acquire factories or entire production lines in China, often outbidding rivals. According to the founder of TAF Drones, Oleksandr Yakovenko, he had negotiated with a Chinese factory that was producing about 100,000 motors per month and he hoped to purchase the entire output for his own company — but before he could finalize the sale, the Russians bought the factory outright.

Another similar case involves Vyriy, led by Aleksey Babenko. A Chinese manufacturer recently informed Babenko that he could order motors almost without waiting in line. When Babenko asked why, the answer was that there was no longer a large Russian buyer. The Russians had purchased the production lines of that Chinese firm, with the intention of relocating or building them inside Russia; after the relocation of one of the factories, the Russian buyer became self-sufficient, and thus commercial opportunities opened up for Ukraine.

What this means practically is that Russia secures priority access to high-demand components (motors etc.), often on favorable terms, because once they own production capacity they can redirect output for themselves. Because Russia is able to invest heavily and take over both the manufacturing site or the associated factories / production lines, they not only ensure a more reliable and abundant supply but also reduce dependency on external suppliers. For Ukrainian producers, this means that even when demand is high, their growth is constrained by component shortages, delayed deliveries, and increasing competition for remaining capacity. [23]

Constraints Facing Ukraine's Drone Manufacturers

The combined effect of these measures was a sharp increase in drone prices. Ukrainian drone manufacturers reported as early as February 2024 that obtaining Chinese flight controllers had become extremely difficult, with some components tripling in price. [24] By mid-2025, Chinese suppliers were demanding double or more for many items, citing the cost and risk of navigating export licenses. For example, in the U.S. market, thermal imaging systems became particularly problematic, while the price of high-end infrared modules rose from $400–500 to more than $1,500. [25] The escalation of the U.S.–China trade war compounded

22. Shchur, M. (2025, September 4). China continues to sustain Russia's drone industry. NV. https://english.nv.ua
23. Khalilov, R. (2024, January 25). "Коли росіяни масово сядуть на FPV-дрони з машинним зором, буде біда". Як нове покоління дронів може змінити хід війни ["When Russians massively adopt FPV drones with machine vision, it will be a disaster": How a new generation of drones could change the course of the war]. Ukrainska Pravda. www.pravda.com.ua
24. Hambling, D. (2024, February 15). Ukraine makes drone flight controllers, breaking free of China. Forbes. www.forbes.com
25. DroneXL. (2025, June 26). Chinese drone component prices surge. DroneXL. https://dronexl.co

the problem: in April 2025, the United States imposed a 125% tariff on Chinese drones, lifting total import duties to about 170% and driving prices up nearly threefold.

Although Ukraine can still obtain drones and components through intermediaries in countries such as Poland, Vietnam, and the UAE, this approach increases costs and extends delivery times. According to the CEO of Vyriy Drone, Oleksiy Babenko, the price effect of imports via third countries averages 1–2%, but delays are a greater constraint. [26] The September 2024 restrictions were particularly disruptive because they limited shipments of motors, cameras, and radio-frequency modules by parcel post.

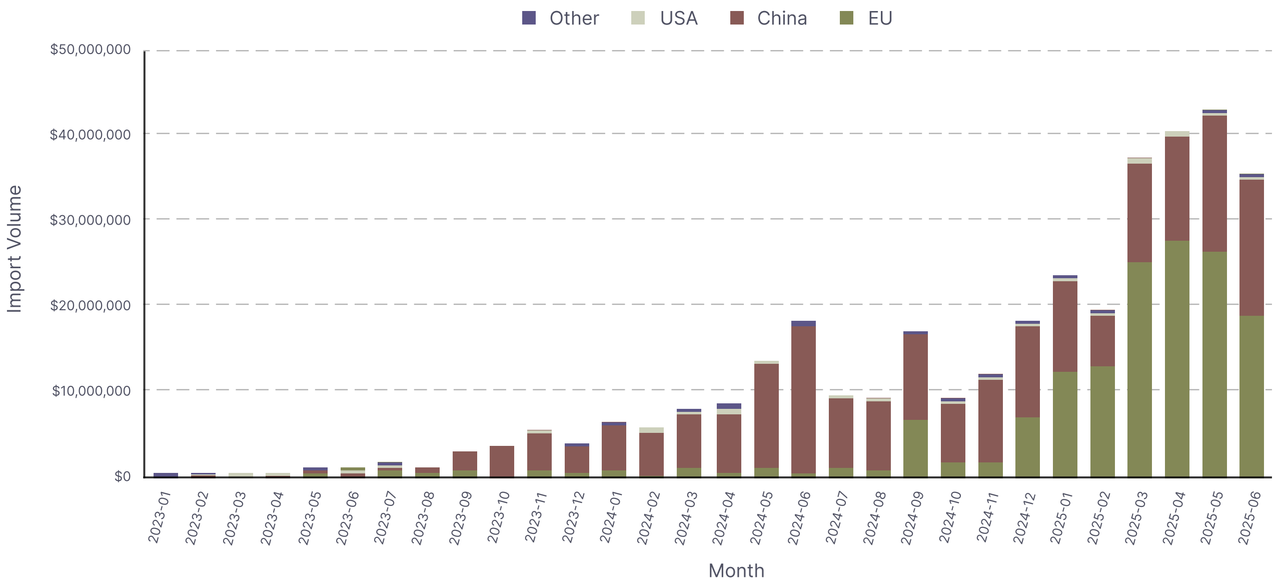
This forced Ukrainian firms to adapt in three ways: relying on intermediaries, diversifying toward suppliers in Taiwan, South Korea, and Europe, substituting some components domestically, and introducing tactical innovations such as fiber-optic control systems, which allowed strike drones to operate effectively in jammed environments without vulnerable radio links.

These shifts contributed to a rapid change in Ukraine's import structure. At the beginning of 2024, nearly 90% of the total value of imported drone components came from China. By the first half of 2025, this share had dropped to about 38%, with most of the remainder sourced from European Union suppliers (see Fig. 8). A similar trend can be observed in the import data of fully built UAS: starting in May 2025, the Chinese share of imports fell to 86% in June – an unprecedentedly low figure, given that it had consistently remained above 95% before (see Fig. 9).

Nevertheless, substitution remains incomplete. Some categories of Chinese-made components, especially microelectronics, still lack viable alternatives. SII and UCDI's surveying confirmed that nearly all firms — except one — continued to import at least some components from China. At the same time, a majority of respondents, 76.7%, indicated that they would abandon Chinese sourcing altogether if competitive alternatives became available.

This result underscores the strong preference among Ukrainian producers to diversify away from Chinese supply chains if competitive alternatives become available. It provides a natural transition to examining the barriers that prevent full localization, despite such clear intent.

Figure 8: Regional breakdown of UAS component imports (Source: State Statistics Service of Ukraine).



26. UNIAN. (2025, May 1). Там, де китайський дрон полетить лише на 5 кілометрів, український – на всі 20, і це за ту саму ціну — Олексій Бабенко, CEO «Вирій Дрон». UNIAN. https://www.unian.ua

Figure 9: Share of Chinese Drones in Fully Assembled UAS Imports (Source: State Statistics Service of Ukraine).

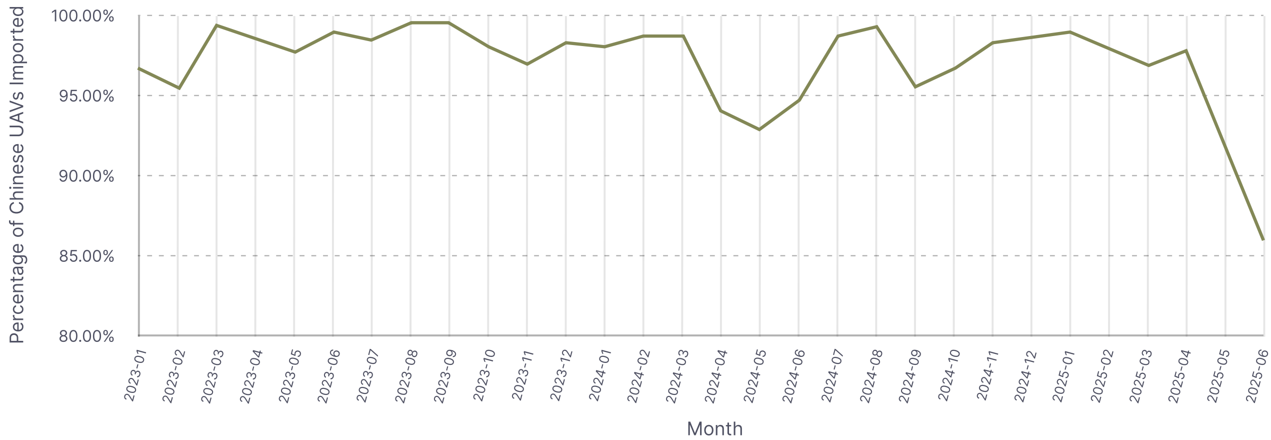
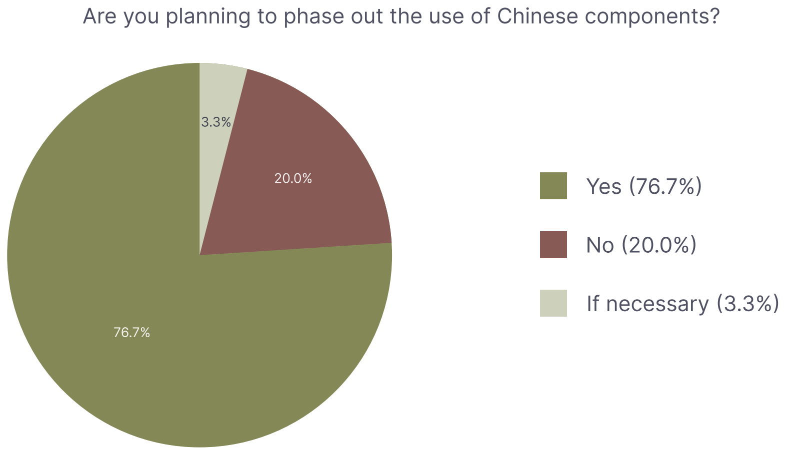


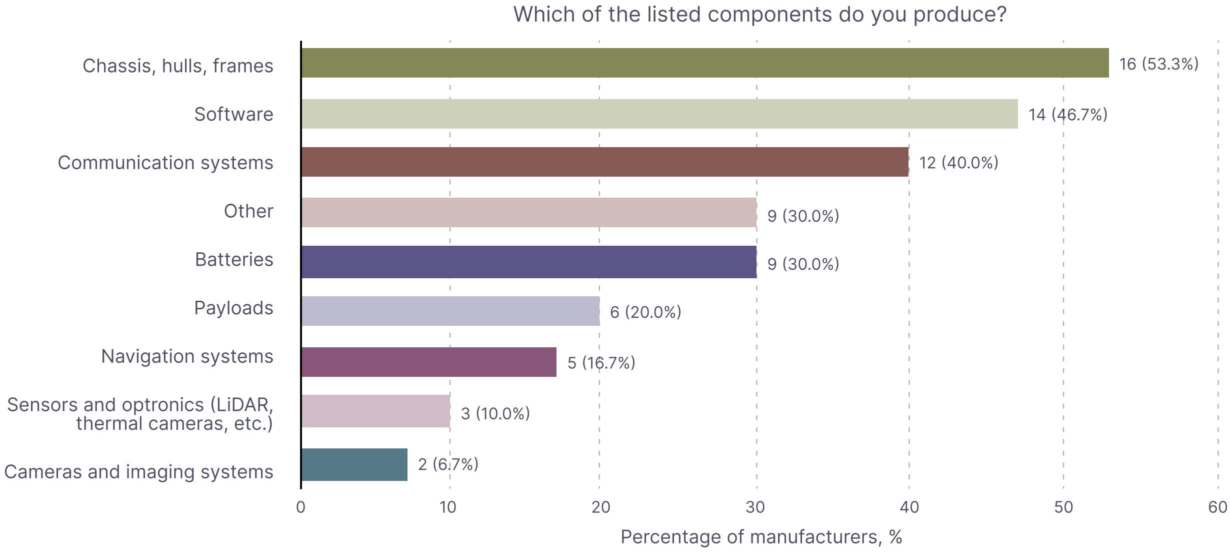
Figure 10: Do manufacturers plan to phase out the use of Chinese components?



Why Certain UAS Components Have Not Been Localized

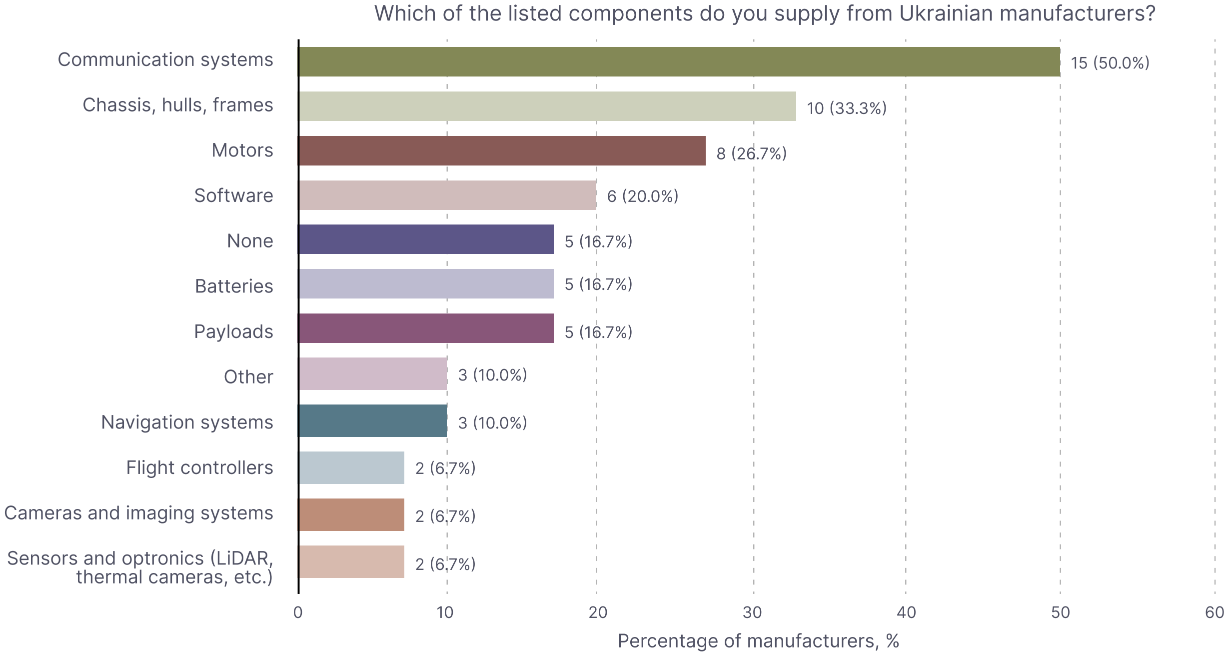
Despite impressive wartime innovation, not all critical subsystems have been brought under domestic control. Several components remain foreign-sourced because they are technologically complex, IP-protected, capital-intensive, and tied to fragile global supply chains. Ukraine's startups can assemble and ruggedize, but they cannot easily reproduce decades of specialized chemical, material, or electronic expertise.

Figure 11: Component types produced by surveyed manufacturers.



The largest group of companies surveyed (16 firms, 53.3%) reported producing chassis, hulls, and airframes. Fourteen firms (46.7%) indicated they work on software solutions, while twelve (40%) are engaged in communication systems. Nine companies (30%) reported producing batteries, and another nine (30%) fell into the "other" category, which included supporting infrastructure and specialized subsystems. Six respondents (20%) noted they manufacture payloads, and five firms (16.7%) reported producing navigation systems. At the lower end of the distribution, a few companies are involved in sensors and supporting electronics, such as LiDAR, thermal cameras, and other imaging devices.

Figure 12: Component types supplied from the domestic market.



According to the survey results, most companies reported sourcing communication systems from Ukrainian manufacturers. A smaller, yet still notable group obtains chassis, hulls, and airframes. Motors are also supplied by Ukrainian firms, though to a lesser extent, while only a limited number of companies turn to local providers for batteries and payloads. Advanced systems such as navigation equipment, flight controllers, sensors, optics, and visualization technologies are sourced from Ukrainian suppliers only rarely. Five manufacturers stated that they do not source anything from the domestic market.

Survey responses also reflect how Chinese dependency manifests in practice. While Ukrainian producers have localized airframes, electronics housings, and some communications systems, the technologically complex subsystems — from advanced optics and navigation chips to battery chemistries — remain firmly tied to Chinese supply chains. Without access to these inputs, domestic manufacturers cannot assemble functioning UASs at the scale required by the Armed Forces. Even when European or American alternatives are technically viable, long qualification cycles, certification requirements, and performance risks often make substitution impractical.

Beyond dependency on foreign suppliers, Ukrainian producers also face persistent logistical and production-related difficulties. Survey data shows that

Figure 13: Regions from which surveyed manufacturers import components.

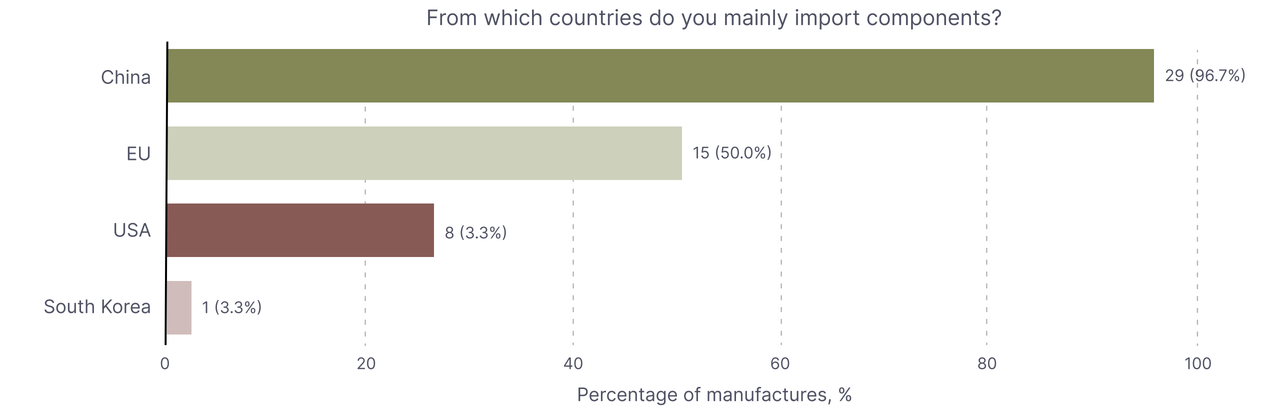
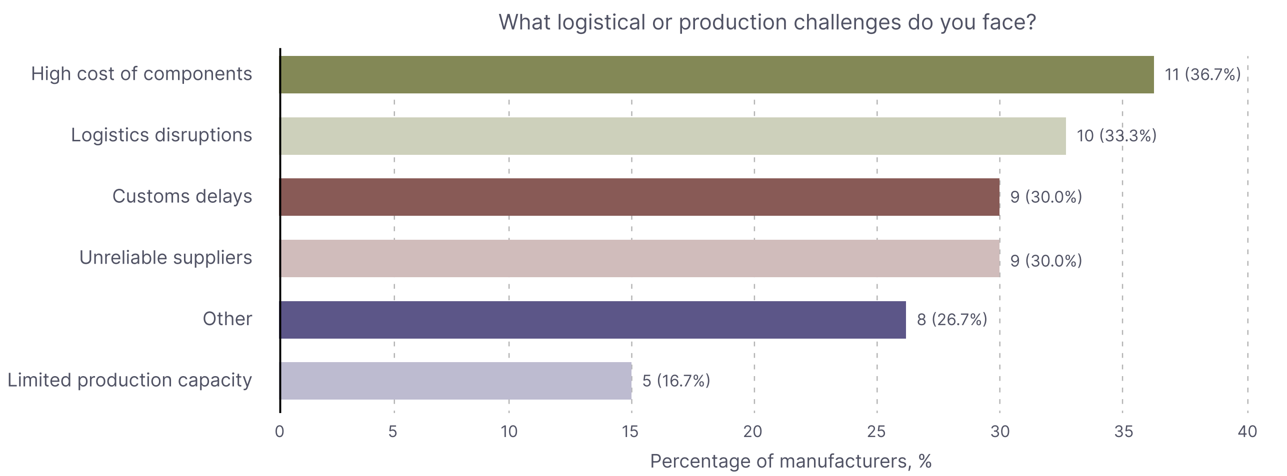


Figure 14: Key issues faced by surveyed manufacturers.



the most common issue is the high cost of components, reported by 36.7% of respondents. This reflects how export restrictions, intermediary routes, and shrinking availability have driven up prices across the supply chain. A third of surveyed companies (33.3%) pointed to logistical disruptions, such as longer delivery times and unreliable transport corridors. Another 30% reported customs delays and an equal share emphasized unreliability of suppliers, often linked to sudden changes in export license approvals or shifting Chinese regulatory enforcement. Finally, five companies noted limited production capacity, indicating that even domestic firms struggle to scale output fast enough to meet frontline demand. Together, these responses show that the barriers to localization are not only technological but also economic and logistical.

Ukraine's localization success has been greatest where engineering improvisation and rapid assembly can compensate for import gaps—airframes, electronics housings, battery pack assembly. But in components bound by chemistry, IP, scale, and certification, foreign dependence remains entrenched. This explains why optics, navigation chips, separators, and LiPo chemistries are still imported despite the urgency of war. Without large-scale allied investment or licensed IP transfers, these chokepoints will persist—and adversaries or third-party states can exploit them.

Airframes, Hulls, and Chassis

Structural components show the most successful localization. Early in the war, many drone airframes (frames, shells, propeller blades) were imported or repurposed from commercial kits, largely from China. Over time, Ukrainian makers have localized much of the airframe production. Most FPV and multirotor drones now use frames cut or molded in Ukraine (often from imported carbon fiber sheets or locally sourced composites). More than 85% of the manufacturers participating in our survey said that they either manufacture chassis and hulls themselves or supply them from other domestic firms. This strength reflects successful localization of one of the lower-technology but physically demanding parts of a UAV. ISR drones use aerodynamic fuselages fabricated in Ukrainian workshops, often modeled on hobbyist glider designs but reinforced for endurance. Naval drones are assembled in clandestine facilities, where engineers produce stealthy low-profile hulls capable of carrying explosive payloads. Ground drones employ armored tracked or wheeled chassis, locally built with steel plating adapted from civilian industries. A key distinction is that, unlike many other drone components, domestic frame production – particularly for aerial drones – has often been taken up not by newly formed defense startups but by established civilian manufacturers of plastics, aluminum, and other goods, who expanded their product lines to include drones.

In addition, while Ukraine benefits from relatively inexpensive labor, some drone manufacturers report that domestically produced airframes and hulls are priced higher than potential imports from China. More importantly, Ukraine still lacks sufficient production capacity in this area. Investments aimed at scaling up are therefore essential to achieve full independence in the production of structural components.

For the carbon fiber structures, Ukraine depends on imported carbon composites and alloys, leaving material inputs as a lingering vulnerability. Still, there has been progress: some manufacturers have developed competencies in creating composite materials, including producing carbon fiber from filament.

Avionics and Flight Control

At the beginning of the full-scale war, avionics was one of the weakest points of Ukrainian drones. Hobby-level autopilot boards and Electronic Speed Controllers (ESCs) from China were mostly used, and they often failed under combat loads. By 2024, Ukrainian startups funded by BRAVE1 and private grants had begun producing hardened autopilot boards and controllers built to withstand overheating and vibrations.

In 2023–2024, several Ukrainian teams, including Wild Hornets, Vyriy Drone, Tykho, and others, started claiming their own avionics production. This mainly refers to the assembly and firmware flashing of ESCs and flight controllers in Ukraine, while the critical components remain imported.

An analysis of product ranges on marketplaces for drone manufacturers shows that most ready-made solutions in the ESC segment are represented by Chinese brands. The situation is somewhat better with flight controllers, which, in addition to Chinese products, also include European and even Ukrainian manufacturers. For example, Vyriy offers a stack positioned as an alternative to the Chinese product from SpeedyBee. Although its specifications are not fully published, it is known that the microcontroller comes from a European manufacturer, the inertial sensor is declared as being from a Japanese manufacturer, and the OSD chip is of Chinese origin.

Other Ukrainian companies that produce their own flight controllers find themselves in a similar position. For example, Tykho specifies the use of components such as an MCU and magnetometer from STMicroelectronics (EU), inertial sensors from TDK InvenSense (Japan), and a barometer from Infineon Technologies (Germany). The only chip with a clearly Chinese origin is the AT7456E, responsible for the on-screen display (OSD). The rest of the components — power regulators, Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFETs), quartz resonators, connectors — are of unknown origin. Mass production of such parts is concentrated in China and Taiwan. While alternatives from the U.S., EU, or Japan exist, they are significantly more expensive, on average 2-4 times.

Some Ukrainian drone manufacturers also claim to use their own ESCs and controllers. Vyriy Drone announced a batch of 1,000 FPV drones assembled with “Ukrainian frames, flight controllers, initiation boards, radio communication systems, video transmitters, motors, and thermal cameras.” Wild Hornets made similar statements. This localized approach shortens the feedback loop—design changes can be tested at the front within a few days, whereas importing ready-made solutions from China would take weeks or even months.

However, despite these efforts, not all components have domestic alternatives. According to manufacturers, a critical example is the Australian CubePilot Orange flight controller, which has no Ukrainian substitute and therefore must be imported. Luckily, its Australian (rather than Chinese) origin reduces the urgency for Ukrainian manufacturers to localize and create an alternative, as reliance on a trusted Western supplier is seen as less risky.

Industry sources also noted that Printed Circuit Board (PCB) assembly is often carried out in Ukraine, though the printed circuit boards themselves are mostly fabricated in China. Complex multilayer boards are almost always ordered from Chinese factories, while Surface Mount Devices (SMD) soldering and final assembly are performed by Ukrainian companies. Producers try to rely on European, American, and Japanese suppliers for key chips, but in power and auxiliary electronics, a large share is still likely of Chinese origin. [27]

One of the largest dependencies is the OSD chip (used in flight controllers to overlay telemetry on the drone's video signal — for example, displaying speed, altitude, battery level, or GPS coordinates directly in the pilot's video stream), the AT7456E, which is the most common chip in drone construction and standard for FPV systems. Its production is concentrated exclusively in China: Western and Japanese companies do not produce specialized OSD controllers, since this is a niche segment with relatively low global demand. In the EU or the U.S., FPGAs or separate video processors are more often used for similar tasks, which are much more expensive and more difficult to integrate. Therefore, the Chinese AT7456E remains the only affordable and widely used solution for FPV drones. Beyond that, it is highly likely that voltage regulators, MOSFETs, quartz resonators, and connectors in Ukrainian-made flight controllers and ESCs also come from Chinese or Taiwanese suppliers.

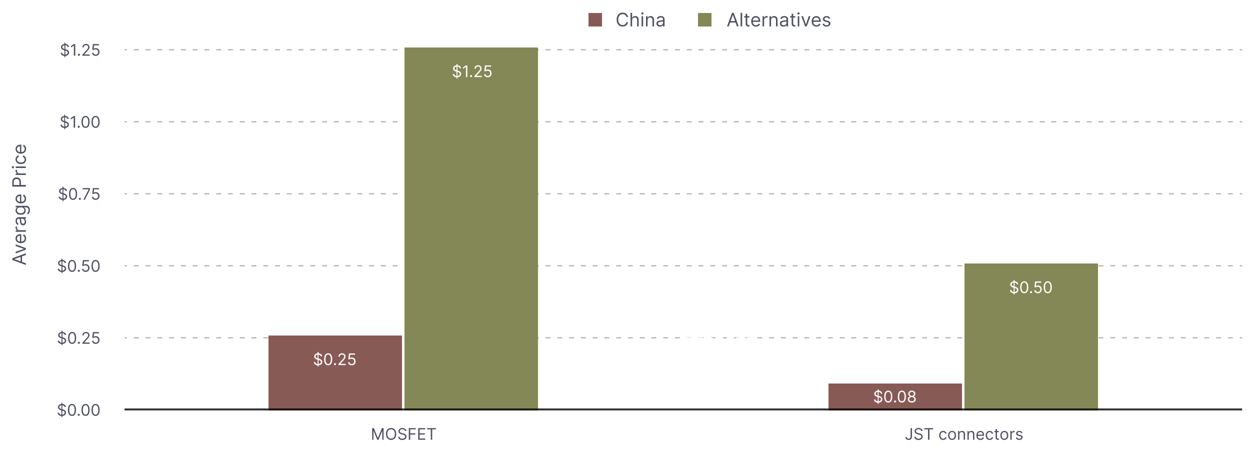
Replacement is theoretically possible. U.S., European, and Japanese companies do manufacture equivalents — for example, Texas Instruments MOSFETs (USA), Infineon power regulators (Germany), or Murata quartz resonators (Japan). Yet the price differential is substantial: a Chinese MOSFET suitable for ESC applications can cost $0.20–0.30 in bulk on LCSC — one of the largest Chinese online distributors of electronic components — while a comparable Infineon or TI component on Digi-Key or Mouser may retail for $1–1.50. Similarly, JST-style connectors from Chinese factories sell for $0.05–0.10 apiece, while Molex (USA) or Hirose (Japan) versions often exceed $0.50.

27. Hambling, D. (2024, February 15). Ukraine makes drone flight controllers, breaking free of China. Forbes.https://www.forbes.com

For high-volume drone production, these multipliers are prohibitive.

Localizing such production in Ukraine is not realistic in the near term. Manufacturing even "simple" MOSFETs or quartz resonators requires a semiconductor fabrication ecosystem, photolithography lines, and precision chemical processes — industries that do not currently exist domestically. As a result, dependence on Chinese suppliers for these second-tier but indispensable components remains unavoidable. Ukrainian firms are mitigating this by sourcing critical computing elements — microcontrollers and sensors — from Western or Japanese vendors, but complete decoupling from Chinese supply chains in power and auxiliary electronics is not feasible under present conditions.

Figure 15: Average price comparison of selected electronic components.



Cameras and Sensors

Most unmanned systems rely on cameras – both standard electro-optical video cameras and infrared/thermal imagers – for navigation and targeting. Initially, Ukrainian drones cannibalized GoPro-style action cameras or used Chinese-made FPV cameras from DJI or CADDX. Almost all of these cameras were imported, mainly from China.

That is fortunately changing. There are now at least four Ukrainian producers of thermal cameras for unmanned systems – Odd Systems, SeekUAV, Oko Camera, and Ochi Nochi – and their finished products have been very successful. The most common models, Kurbas-256 by Odd Systems and SeekUAV-256 by SeekUAV, are priced comparably to – and, for larger orders, even cheaper than – the comparable CADDX-256 model. [28]

In addition, domestic producers can iterate quickly on military feedback: their cameras can, for example, change image contrast in flight to help pilots locate targets. As a result, we see Oko Camera's models deployed on the widely known and successful Ukrainian Skyfall Vampire UAV, and Odd Systems' new Kurbas-640-Alpha model has been used in Ukrainian interceptor drones that proved effective against Russian and Iranian strike UAVs in the past few months. However, the production of key camera components in Ukraine remains impossible; therefore, these firms still rely on foreign components. Odd Systems and SeekUAV rely on lenses and sensors manufactured in China. SeekUAV reports they are trying to reduce reliance on China and source more American lenses, which can, however, raise camera prices. Oko Camera says it follows a "China-less" policy where possible,

28. Yan, O. (2024, December 31). No more "Made in China": Ukraine inches closer to self-sufficient FPV drone manufacturing. Militarnyi. militarnyi.com

attempting to import microcomponents for the circuit boards from Europe and the United States. [29] Still, according to Oko Camera, it is impossible to completely eliminate dependence on Chinese components in the sensor area: for example, China controls over 80% of global germanium production, allowing it to offer much lower prices for products that rely on this material – specifically, thermal sensors. [30]

As a result, by some estimates, roughly 90% of the thermal imagers sold in Ukraine are Chinese, the number of firms trying to localize production is extremely small compared with other subsystems. Large investments would be required to produce lenses or sensors on-site. Until that option becomes available, Ukrainian producers should at least follow what the four companies above are doing: manufacture finished products in Ukraine while actively seeking alternatives for sensors, lenses, and microcomponents outside China.

Communications and Radios

Effective drones need reliable data links and control stations. In early 2022, Ukraine used Chinese radio modules on 2.4 and 5.8 GHz bands, which worked for short-range quadcopters but were vulnerable to Russian jamming. By 2023, Ukrainian teams added analog diversity receivers and digital mesh networks to extend drone endurance.

At the tactical datalink level, the global defense leaders are Silvus Technologies' StreamCaster MANET radios (U.S.), Domo Tactical Communications (DTC) SOLO8 family (U.K.), and Persistent Systems Wave Relay (U.S.). All are fielded for low-latency C2/video under EW pressure. On the COTS side, early FPVs used dominant analog/video vendors such as ImmersionRC (Switzerland), RushFPV (China), and Foxeer (China). On digital FPV, Chinese DJI's O3/OcuSync, Walksnail/Avatar, and HDZero (Divimath) set the market baseline for bitrate and latency. For long-range connectivity, Ukraine relies on satellite backhaul. Starlink's LEO terminals provide high-throughput, low-latency links for command, telemetry, and payload data. That dependence is a vulnerability: periods when Starlink service was interrupted or unavailable for technical, regulatory, or operational reasons have, at times, materially undermined operations.

Within that market, localization has advanced fastest at the module and integration layer, where capital and compliance hurdles are manageable. Several teams now design and assemble analog video transmitters domestically. DEC-1's 2.5-watt VTX is one example, stocked by Ukrainian retailers and already integrated by local airframe makers. In handheld tactical radios, HIMERA's G1 Pro is designed and built in Ukraine and has moved from frontline feedback to repeat production. [31] These efforts show that Ukraine can handle design, assembly, enclosure manufacture, harnessing, and ground-kit integration for the core building blocks of short-range communications. They do not yet replace the top tier of Western MANET radios but reduce exposure to opaque foreign stacks and shorten the time from field feedback to hardware and firmware changes.

Antennas are a particularly active segment. Ukrainian firms, such as 2E, Otaman, Piranha-Tech, etc. fabricate whips, patches, and PCB-based antennas and can pair them with domestically produced mounts and housings. [32] According to the manufacturers, the limiting factor is calibrated test infrastructure. With few full-size anechoic chambers available, producers rely on improvised rigs. This keeps costs down but slows repeatable performance gains.

29. Zhakhalov, Y. (2024, October 21). «Кожен айтівець мусить взяти шефство над одним науковцем». CTO Oko Camera про науку, конкуренцію з Китаєм і роботу для IT-фахівців ["Every IT specialist should mentor one scientist": Oko Camera CTO on science, competition with China, and jobs for IT professionals]. Dou.ua.dou.ua
30. Kryzhanivska, O. (2025, August 16). FPV drone localization in Ukraine. Ukraine's Arms Monitor (Substack). ukrainesarmsmonitor.substack.com
31. Ukraine's Arms Monitor. (2025, August 7–13). Drone warfare in Ukraine: Military communications, EW and long-range drones. Ukraine's Arms Monitor (Substack). ukrainesarmsmonitor.substack.com

In practice, many PCB antennas are still ordered from Chinese labs for price and turnaround, even when designed locally.

Tethered control has also moved from prototypes to production. Ukrainian firms such as 3DTech machine and assemble fiber-optic reels, standardize coil formats, and integrate tether kits on airframes. The fiber is imported, but recent announcements indicate that domestic suppliers now mass-produce 25–30 km spools and participate in codification trials. [33] Media converters continue to be a vulnerability, as only one domestic producer exists. Most units are based on Chinese reference designs, resulting in limited alternative sourcing and design variation. Ukraine manufactures the mechanical components and manages airframe integration, enabling a fiber-tether control path that is resistant to RF jamming. However, optical fiber and most active electronics, including media-converter boards and power or signal modules, are still imported.

Against that baseline, localization runs into hard limits at the element base. According to a domestic manufacturer interviewed, access to key semiconductors and multilayer printed-circuit boards is constrained, so the most advanced communications parts remain largely imported. This typically includes RF front-end devices (power amplifiers, low-noise amplifiers, integrated FEMs), precision RF filters (SAW/BAW), secure-element chips for key storage and device authentication, and digital radio chipsets used in low-latency links. While layout and assembly are increasingly done in Ukraine, complex multilayer PCBs on low-loss laminates are still fabricated abroad for cost, impedance control, and yield reasons. Building these capabilities domestically would require multi-year investment in materials, process control, and calibrated test capacity.

Two forces sustain that dependence. The first is policy. From 1 September 2023, China required licenses for a range of drone-related goods. These include radio and communications equipment and certain engines and lasers. In practical terms, Chinese procurement routes are now license-bound for classes of communications and sensing parts relevant to combat UAS. This adds documentation, delays, and denials. Distributors in other regions apply their own end-use and diversion screens. This further narrows what they will ship to programs with clear military application.

The second force is economics and infrastructure. Standing up multilayer RF PCB lines with aerospace-grade materials, metrology, and yield control, or a domestic fiber draw tower, requires multi-year, eight-figure investments, assured materials, and process expertise. Ukraine can and does assemble modules around imported silicon. It increasingly manufactures the surrounding mechanics, but in the near term it will continue to import RF front-ends, SAW/BAW filters, secure-element silicon, fiber, and many power- and connector-level parts.

Security and provenance considerations reinforce this trajectory. Vendor-controlled software can change behavior suddenly and may transmit data that operators prefer to keep private. Chinese communication systems, such as DJI can be remotely disabled, rely on closed protocols that block customization, and may even allow manipulation of transmitted video or telemetry, undermining confidence in targeting. [34]

Navigation Systems

Navigation has been a core vulnerability for Ukrainian drones throughout the war, as Russian electronic warfare frequently disrupts GNSS signals. The resulting loss of real-time data and control has created persistent tactical disadvantages. Ukraine remains reliant on imported navigation components — including GNSS receiver silicon and MEMS sensors — sourced mainly from a small set of Western and Asian producers.

32. IRON Cluster. Products of IRON Cluster manufacturers. TediBoa. tediboa.com.tw
33. Defense Express. (2025, May 1). New Domestic 30 km Fiber-Optic System for FPV Drones to Strengthen Ukraine's Armed Forces. en.defence-ua.com
34. Schiller, N., Chlosta, M., Schloegel, M., Bars, N., Eisenhofer, T., Scharnowski, T., Domke, F., Schönherr, L., & Holz, T. (2023). Drone security and the mysterious case of DJI's DroneID. semanticscholar.org

On the **GNSS** side, Switzerland's u-blox is a leading supplier, with modules widely used in civilian navigation devices, with about 1 billion units deployed in 2024. [35] Other major GNSS chipset suppliers include Broadcom, Qualcomm, and Intel (USA), MediaTek (Taiwan), and Quectel and Unicore (China). Leading **MEMS** and **IMU** providers are STMicroelectronics (EU), Bosch Sensortec (Germany), Qorvo, Analog Devices (U.S.), and TDK/InvenSense (Japan). As of mid-2025, Ukraine imported 304 shipments of GNSS receivers from 67 suppliers, mostly from China, Belgium, and the U.S. [36] There is no open-source data on MEMS volumes or Ukraine's top suppliers, but the main supplier regions are China, the EU, and the U.S.

Ukraine lacks domestic mass production for drone components, including GNSS chipsets and MEMS. Building these capabilities requires significant time and substantial investment in fabrication and calibration facilities, which Ukraine does not currently possess at scale. However, some firms are localizing the manufacturing of navigation systems. The defense-tech startup LFTX has developed the Sokil/Sova navigation module and the Scout map correction module. [37] Civilian companies like Geometer International produce GNSS and RTK receivers. There is no open-source information on Ukraine-produced IMU systems, such as gyroscopes or accelerometers. As core components are likely sourced from abroad, Ukraine primarily assembles these into ready-to-integrate modules.

Power Systems

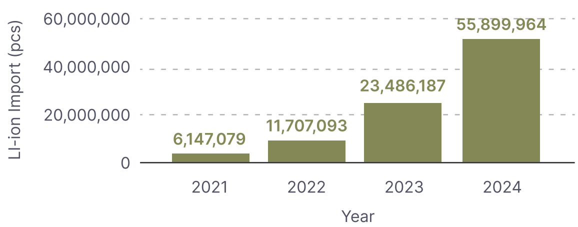
Batteries (typically lithium-ion or lithium-polymer) are another Achilles heel for global drone supply. In 2022, a period with minimal domestic production and external reliance on the assembled platforms, battery packs were almost entirely imported. Cells varied in quality, with many overheating or losing charge rapidly in winter. Ukrainian soldiers reported FPV sorties cut short due to sudden voltage drops. By mid-2023, local workshops began assembling domestic battery packs using imported cells from China and South Korea, improving reliability by standardizing battery management systems (BMS). This lowered costs and allowed scaling, as importing cells rather than fully assembled packs both expanded the pool of available suppliers and eliminated the added value on finished products. Local assembly also made it possible to customize packs for different drone types. However, the chemistry, lithium polymer, lithium-ion, still tied Ukraine to Asian suppliers.

China accounts for 85% of global EV capacity, with CATL being the world's largest Li-ion battery maker, and Chinese firms dominate the market for the small high-discharge batteries used in quadcopters. [38] However, three out of the world's five largest cell producers – LG, Panasonic, and Samsung – are based in South Korea and Japan. [39]

Since importing cells is unavoidable due to the absence of domestic raw materials and chemical production capacity, these suppliers can provide Ukraine with reliable alternatives and help reduce dependence on China in battery pack assembly.

This is precisely the solution Ukrainian producers are already pursuing. Wild Hornets assembles battery packs using Korean Samsung 50S and American Westinghouse cells. So does Pawell, assembling packs compatible with different UAV models, with most based on Samsung cells. Alternatively, Accum Systems chooses to rely on Taiwanese Molicel cells for its production. The finished packs are priced at $90–$130 each, placing them in the same range as foreign competitors.

Figure 16: Annual imports of Li-ion cells and packs, 2021-2024 (Source: State Statistics Service of Ukraine).



Motors

Small electric motors (the type that drive propellers on quadcopters and FPV drones) are a notorious dependency. Until recently, virtually all drone motors were purchased from Chinese manufacturers like T-Motor or Foxeer. In 2023, Ukraine had no local motor producers, and few even considered making them. That changed as the war spurred entrepreneurs to fill this gap. Motor-G, a Ukrainian startup, spent a year and a half developing domestic drone motors; by December 2024, it launched mass production and is now approaching 100,000 motors per month in output. Motor-G's factory is likely the largest drone motor plant in Europe, addressing a critical bottleneck. These motors power Ukraine's FPV drones and new fiber-optic tethered drones, up to 15-inch frame size. However, with the targeted production of 400,000 FPV systems per month — and considering that each drone typically requires up to four motors — total demand would amount to around 1.6 million units. This gap illustrates a broader trend seen across other sub-components as well: domestic capacity, while growing, remains far below the levels required for full-scale drone production.

Even Motor-G must still import certain inputs – for example, the high-grade magnets and copper wire for its motors, as well as specialized winding and testing machines, largely come from China or other foreign sources. Thus, while Ukraine now produces motors, it remains indirectly dependent on Chinese materials and equipment to do so. If those supplies were cut (e.g. China restricting magnet exports), motor production would stall. Additionally, for larger drones that use internal combustion engines (like some long-range UAVs), engines are typically foreign-sourced (e.g. Austrian-made Rotax engines or Chinese-made piston engines). Manufacturers striving for maximum localization report that they have switched to Ukrainian-made solutions for small motors, but still lack domestic alternatives for larger models. At the same time, in 2021, Motor Sich established long-term cooperation with the Turkish drone manufacturer Baykar Makina, supplying engines for several of their UAVs. [40] Specifically, the Bayraktar Akıncı is equipped with Motor Sich AI-450 engines, the Baykar MİUS-A uses AI-322F engines, and the Baykar MİUS-B is powered by AI-25TLT engines; Ukraine possesses significant industrial potential and technical capabilities in the production of drone propulsion systems, indicating opportunities to further expand and localize production for both domestic and export-oriented UAV platforms. [41]

The Magnets Problem

FPV and other drones rely on powerful neodymium-iron-boron (NdFeB) permanent magnets in their motors and sensors, primarily for brushless direct current (DC) motors that drive the propellers. These magnets provide the high torque and lightweight efficiency that make modern unmanned systems viable. Alternatives, such as ferrite magnets, are cheap and corrosion-resistant but far weaker, making them unsuitable for high-performance or weight-sensitive applications. In practice, neodymium magnets remain indispensable, and the reliance on them creates one of Ukraine's most exposed industrial chokepoints.

NdFeB magnets are chosen for drones because of their high magnetic energy density, which yields strong torque in a lightweight package. Alternatives like ferrite

35. U-blox (2024). Annual report. content.u-blox.com
36. Volza (2025). GNSS Receiver Imports in Ukraine. volza.com
37. IRON Cluster. (n.d.). Products of IRON Cluster manufacturers. TediBoa. tediboa.com.tw
38. The Economist. (2025, June 12). The economic lessons from Ukraine's spectacular drone success. The Economist. economist.com
39. Tamarindo. (2022, September 2). Who are the top 10 battery cell makers? Tamarindo. tamarindo.global

magnets are corrosion-proof and cheap but far weaker, making them unsuitable for high-performance or weight-sensitive UAS applications. Thus, NdFeB remains the magnet of choice, and bonded NdFeB is a newer variant addressing manufacturing needs. In practice, this means Ukraine cannot substitute away from neodymium-based magnets without severe performance loss, reinforcing the criticality of resilient supply lines.

The main use of NdFeB magnets in FPV drones is in brushless direct-current motors that drive propellers. These motors require permanent magnets in the rotor to generate the magnetic field that interacts with the stator coils. Bonded NdFeB magnets — produced by binding magnetic powder with polymer — can be molded into single-piece multi-pole rings, reducing assembly steps. But whether bonded or sintered, the essential input is the same: rare earths processed and fabricated overwhelmingly in China. Ukrainian drone firms that have successfully localized frame, avionics, or optics production remain dependent on imported Chinese magnets to sustain their motor lines.

Magnets also underpin a wide range of smaller subsystems. Bonded NdFeB can be molded into miniature rings or discs for use in high-resolution magnetic encoders, stabilizers, and servomotors. These parts appear in gimbals, payload release mechanisms, and throttle sensors.

While some FPV drones operate sensorless motors, many platforms — particularly those carrying heavy payloads or requiring stabilization — rely on precise magnet-based components. This reinforces the fact that magnets are not a peripheral issue but central to the performance of entire classes of unmanned systems.

China overwhelmingly dominates the rare earth magnet supply chain, not only in mining these rare earths but also processing — handling 98% of global refining, and accounting for over 80% of global NdFeB magnet output. In 2024 China's magnet output was estimated at 300,000 tons, whereas the US, for example, produced virtually none that year. This quasi-monopolistic position has given China immense leverage. For FPV drones and other UAVs, this means most high-performance magnets (or the alloy powder used to make them) originate from China's supply chain. Ukraine's drone industry, though agile, remains tied into this same supply chain — making it highly exposed to Chinese export decisions.

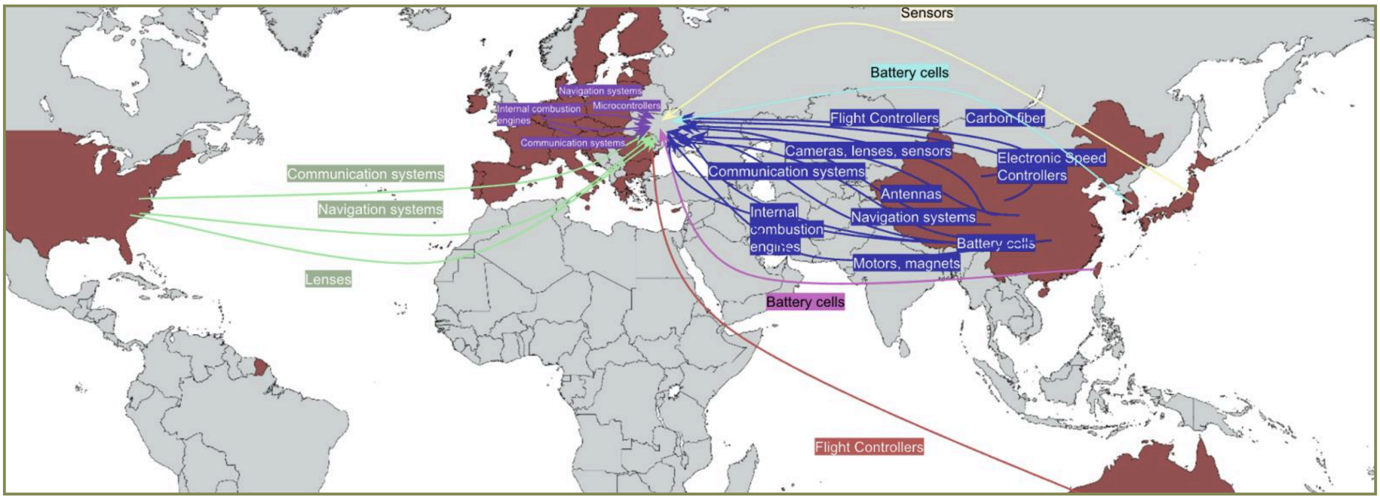
If China fully restricts supply, prices would rise sharply, stockpiles would run out, and critical allied industries, from wind power to defense, would face disruptions. China's recent policy moves illustrate the risk: in April 2025, China imposed new export licensing restrictions on a set of critical rare earth elements (such as dysprosium, terbium, samarium, and others) and on certain NdFeB magnet products. Exporters must now apply for special permits to ship these materials out of China. This policy – viewed as retaliation to Western trade measures – has already started upending global supply chains. Magnet buyers faced extended lead times and rising costs, as Chinese customs approvals can delay each shipment by weeks. By mid-2025, industries worldwide were reporting shortages and surging prices. Some defense contractors cited samarium offered at sixty times its normal price; other rare earth inputs rose fivefold. Automakers slowed production, and defense suppliers warned of higher system costs. For Ukraine, which consumes magnets at unprecedented volumes in FPV and strike drone production, such disruptions translate directly into battlefield risk.

Modern drones cannot function without NdFeB magnets (for motors, servos, sensors, etc.), and were a geopolitical crisis to prompt China to embargo magnet exports to certain countries, those countries' drone fleets could quickly be endangered. A case in point: in 2024, Vyriy Drone set out to build FPV drones with fully local components to avoid reliance on Chinese parts. They succeeded for most components – but not the magnets. The firm still had to use Chinese-made neodymium magnets and some electronics, citing "China's global monopoly" on those items. Even innovative local manufacturing cannot yet escape China's dominance in magnets. It also raises the question: if China were to cut off magnet exports (to Ukraine or the West), how quickly could drone producers source alternatives?

40. Defense UA. (2025, March 12). Motor Sich has signed a long-term cooperation deal with Turkey's Baykar Makina. https://en.defence-ua.com
41. Sanal Savunma. (2020, July 15). Baykar'ın insansız savaş uçağı projesi MIUS. https://web.archive.org
42. Discovery Alert. (2025, September 10). Rare earth minerals and their role in 2025 modern technology. https://discoveryalert.com.au
43. TSN. (2025, September 12). Рідкісноземельні метали та уран: експертка оцінила масштаби покладів в Україні та які родовища вже захопила Росія.https://tsn.ua

Ukraine sits atop rare earth deposits in the Azov Upland region and in Kruta Balka, but these areas are occupied by Russia, making domestic extraction impossible. Even if accessible, the cost of mining these resources is prohibitively high, preventing Ukraine from achieving independence from the Chinese magnet supply. Instead, Ukraine can play a different role: it can support Western efforts to reduce supply chain dependency by supplying accessible rare earth materials through implementing the rare earth agreement with the US, providing feedback on how they perform in military applications, participating in testing and R&D. By integrating with Western supply chains, Ukraine contributes to resilience in magnet-dependent technologies while advancing its own industrial expertise, even without achieving full independence from Chinese sources.

Mapping domestic capabilities



Component	Primary Supply Source	Alternative Sources	Status	Details
Airframes, Hulls, and Chassis	Ukraine, China	EU, USA (composites, alloys)	Localized	Aluminum structures are fully localized, while carbon fiber parts remain dependent on imported raw material, despite some progress in domestic composite development. Domestic products can be more expensive, and capacity is limited.
Flight controllers	China, Australia (CubePilot Orange), Ukraine	EU, Japan	Partially localized assembly; impossible full localization	Firmware flashing, and some Ukrainian-designed stacks; critical chips imported (MCUs, sensors from EU/Japan; OSD from China).
Electronic Speed Controllers (ESCs)	China	Taiwan, USA, EU, Japan (connectors, transistors, and other sub-components)	Potential for localized final assembly; impossible full localization	Most ESCs are sourced from China. Some are assembled and firmware-flashed in Ukraine, but MOSFETs, regulators, and other chips are imported from China or Taiwan, with alternatives available at much higher cost.
Thermal Cameras	China, Ukraine	US (some lenses), EU (microcomponents)	Partial localization; impossible full localization	Ukrainian firms design and assemble thermal imagers and compete with Chinese models, but rely on imported lenses and sensors from China. Some effort to diversify to U.S./EU suppliers, but costs are higher.
Antennas	China	N/A	Partial localization	Some fabrication and mounting are done domestically; limited by test facilities, many PCB antennas are imported from China.
Other communication systems, including video transmitters (VTX), receivers, and radios	China, Ukraine, USA	EU, Switzerland	Partial localization; difficult to localize	Some domestic design/assembly of VTX and radios; high-end MANET radios entirely imported; reliance on foreign chips/PCBs.
Navigation Systems	China, Belgium, USA	Switzerland, EU, Taiwan	Difficult to localize	All GNSS chipsets, MEMS, and IMUs are imported, with some cases of final assembly of navigation modules.
Batteries	China, South Korea, Ukraine	Taiwan, Japan	Localized assembly; impossible full localization	Domestic assembly is widely established. Full dependence on imports of cells due to a lack of materials and the chemical industry.
Electric motors	China, Ukraine	N/A	Partially localized assembly; impossible full localization	Motor-G launched mass production in Ukraine. However, production depends on imported magnets, copper, and equipment. Magnets cannot be localized or substituted.
Internal combustion engines	Austria, China	Ukraine	Partial localization	Ukraine can produce engines (Motor Sich & Baykar Makina cooperation), but not widely used yet.

44. BBC. (2023, October 18). Ukraine war: Russia launches autumn offensive amid drone attacks. https://www.bbc.com

Ukraine and the Allied Industrial Base

Ukraine's wartime drone industry has grown into one of the most dynamic defense sectors in the world, assembling millions of systems annually and localizing much of the design, assembly, and integration process. Frames, avionics, radios, and even cameras are increasingly produced inside Ukraine.
Yet the foundations of that scale — lithium salts, neodymium magnets, navigation chips, and thermal sensors —remain dependent on foreign suppliers, with China occupying an outsized role. Every new restriction from Beijing has translated into price shocks, delivery delays, and battlefield risk. This tension defines the challenge and opportunity of partnership with the United States and NATO: Ukraine can produce at scale, but to sustain and expand that scale, allied collaboration must target the component chokepoints Ukraine cannot resolve alone.

Western support so far has been meaningful but limited: financial assistance, operator training, and selective technology transfers. The next step is structured integration. Reliable, compliant channels can secure bulk flows of commodity microelectronics that Ukraine now purchases indirectly from Chinese suppliers. Partnerships can also open access to critical items at chokepoints — licensing allied sensor designs, providing secure-element chips or RF front-ends, or extending favorable terms from allied stockpiles. Such measures directly close the vulnerabilities identified in this report.

Joint research and development offers another path. Ukraine's battlefield-proven concepts — from drone swarm coordination to AI-assisted targeting — combined with NATO resources could accelerate next-generation systems. This exchange would allow Ukraine to access funding and advanced technology while giving NATO a steady pipeline of validated solutions. In practice, such collaboration translates Ukraine's wartime improvisation into formalized production processes that meet Alliance requirements.

Economically, allied demand is vital for sustaining Ukraine's scale. Co-production arrangements, licensed final assembly abroad, or exports of kits and sub-assemblies keep Ukrainian factories running at high volumes, reducing unit costs and encouraging supplier investment. Ukraine is already positioned to expand as a direct supplier once conditions allow. The result is not competition with Western industry but complementarity: Ukraine can fill the niche of low-cost, high-volume tactical drones that Western systems do not address.

Strategically, integration into NATO supply chains strengthens the Alliance in ways no other partner can. Each Ukrainian-made motor, optical system, or fiber-optic reel adopted by NATO members is one less item sourced from China. Doing this work in Ukraine leverages an existing industrial base already operating at wartime scale and at lower cost than Western production. Supporting Ukraine's localization drive is therefore not a duplication of what allies could do at home, but a strategic choice to broaden and harden NATO's industrial capacity.

Significant barriers remain. Western procurement is slow and heavily regulated, while Ukraine's advantage lies in agility. Export controls, certification, and interoperability requirements will take time to navigate. Intellectual property concerns and uneven quality control must also be addressed. These are surmountable with longer-term procurement contracts, co-funded testing facilities, and frameworks that treat Ukraine as a collaborator rather than a competitor.

The opportunity is clear. Ukraine has localized under pressure, but the chokepoints identified in this report will persist without allied action. Integrating Ukraine into U.S. and NATO supply chains is an investment in the Alliance's own resilience. The foundation is already in place; what remains is the choice to build with Ukraine, not around it.

Conclusions

Ukraine's wartime drone sector has already altered the conduct of modern conflict. No other nation has scaled from improvised workshops to millions of systems per year under active bombardment. This production miracle has changed how Ukraine fights and how Russia responds, and it has given NATO an early glimpse of the defense industrial landscape of the future. But the deeper lesson is where that scale stops: lithium salts, neodymium magnets, sensors, chips, and optics. These are the choke points of twenty-first century warfare, and they remain dominated by foreign suppliers, above all China.

Ukraine is not the only country affected. The strategic implications for the West became starkly visible when Chinese authorities sanctioned Skydio, America's largest drone manufacturer, cutting off essential battery supplies just days before the 2024 U.S. election. [45] Overnight, the company that was meant to provide an alternative to Chinese manufacturers found itself scrambling for new suppliers, forced to ration batteries to customers including the U.S. military. China's message was unmistakable — supply chain warfare had begun in earnest.

This represents a calculated escalation from China's previous responses to Western restrictions, including the Chip Act in October 2022. [46] During the first Trump administration, Beijing's retaliation remained largely symbolic. Now, China is "signaling their tolerance for accepting and dishing out pain," using its status as the world's factory floor to exact punishment through targeted sanctions that can cripple critical supply chains within days. [47]

The same vulnerabilities plague America's closest allies. Britain's experience with Chinese economic penetration offers a preview of what coordinated supply chain warfare looks like when deployed at scale. Despite recent government intervention to reclaim British Steel from Chinese ownership after allegations of neglect, the UK remains deeply embedded in Chinese-controlled supply chains across critical sectors. From wind turbines that could potentially be shut down remotely to nuclear power plants still partly owned by state-backed Chinese investors, Britain's infrastructure dependencies mirror Ukraine's drone supply chain vulnerabilities writ large.

Even Europe's attempts at strategic autonomy reveal the depth of the challenge. Norway's "invisible mine" project in Ulefoss — touted as Europe's potential rare earth salvation — represents the continent's most promising answer to Chinese rare earth dominance. But this underground operation, designed to extract 9 million tons of rare earth oxides from beneath a small Norwegian village, won't begin full-scale operations until 2030. The timeline underscores how far behind the West has fallen: even if everything proceeds perfectly, Europe's first meaningful alternative to Chinese rare earth supplies is still half a decade away. [49] Europe acknowledges its weakened defense posture and calls for a massive surge in spending, industrial capacity, and military readiness to achieve a credible defense posture by 2030. [50] Yet the underlying reality is that Europe may not have time until 2030, as immediate threats and the outcome of the Russian aggression in Ukraine will shape its security far sooner. Immediate priorities should include rapid procurement, replenishing stockpiles, and securing the supply chains by (but not only) investing in Ukrainian defense and rare earths potential.

Resilience, if built only on improvisation, is temporary. Volunteer networks, grey-market imports, and tactical innovation have kept Ukrainian lines moving, but each new export restriction has been felt immediately at the front. Prices rise, deliveries stall, and combat power erodes. Modern supply chains are not neutral. They are contested terrain, and adversaries will weaponize them just as surely as missiles or artillery.

49. Deutsche Welle. (2025, July 30). This invisible mine could solve Europe's rare earth problem. DW. https://www.dw.com/en/invisible-mine-project-huge-rare-earths-deposit-in-norway-could-reduce-europes-dependency-on-china/a-73213623
50. https://commission.europa.eu/document/download/e6d5db69-e0ab-4bec-9dc0-3867b4373019_en

Conclusions

For the United States and NATO, the strategic implications are immediate. Ukraine's vulnerabilities mirror those of the Alliance itself. The same magnets, lithium chemistries, and optical components Ukraine cannot secure are embedded across Western defense programs. If China can constrain Ukraine today, it can coerce NATO tomorrow. And Ukraine is not just a case study; it is an asset. A defense industry producing at wartime scale already exists on NATO's border. To replicate that capacity in Western capitals would take years and vast sums.

The war over supply chains has already begun, and today the collective West is on the back foot. Reinforcing internal capacity, building new industrial partnerships, and investing in Ukraine's defense industry offer one of the few real chances to preserve the strategic order that democracies depend on.

This is why the harder choice is also the most strategic: to absorb the political and bureaucratic costs of integration now, rather than inherit the same exposure later. Multi-year contracts, co-production, and supply diversification are not favors to Ukraine but safeguards for NATO. The path forward is not about charity but about foresight—whether to treat supply chains as a battlespace and act before dependencies continue to harden into vulnerabilities.

Ukraine has shown what can be built under fire. The question for allies is whether that arsenal remains an isolated national experiment or becomes a shared foundation for collective security before China's supply chain warfare renders such cooperation impossible.

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The Ukrainian Council of Defence Industry

The Ukrainian Council of Defence Industry is an independent association of private arms and military equipment manufacturers that consolidates the sector, strengthens cooperation with the state and international partners, and helps shape Ukraine’s modern security architecture. The Council helps defence producers find partners, scale up production, and access finance and technologies, thereby reinforcing the country’s defence capability.

The Council includes six associations of private defence manufacturers and an investor club. In total, it brings together more than 280 defence producers and is the largest association of its kind in Ukraine.

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