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## **Seven (Initial) Drone Warfare Lessons From Ukraine**

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<https://mwi.usma.edu/seven-initial-drone-warfare-lessons-from-ukraine/>

The ongoing conflict between Ukraine and Russia has seen significant drone use on both sides. Ukraine has made extensive use of drones, from the Turkish-made Bayraktar TB-2 to hobbyist drones supporting civil resistance. Although evidence of Russian drone use early in the conflict was limited, Russia appears to have stepped up its efforts, employing systems like the Orlan-10 and the KUB-BLA loitering munition. Drones have been used in a wide variety of roles from carrying out strikes to guiding artillery and recording video that feeds directly into information operations.

The conflict offers at least seven initial lessons that should influence the thinking of US planners, policymakers, and military leaders about the future of the United States' own drone capabilities. While the conflict is ongoing and some of these lessons may change, the basic points are general enough that even radical changes are likely to add nuance to these points, rather than rendering any of them less meaningful.

### **1. Drone warfare is relevant to conflict with a peer or near-peer adversary , , ,**

Various analysts have been skeptical about the relevance of drones to conflict between advanced militaries. Such forces have sophisticated air defense systems, electronic warfare countermeasures, and specialized counterdrone systems that will rapidly mitigate any drone threat. But that's not what happened in the Ukraine-Russia conflict. For some, even modest air defenses mean drones would play limited roles.

While Russia has shot down a few Ukrainian drones, much of Ukraine's fleet of Bayraktar TB-2s, the Turkish-made military drones that proved devastating in the 2020 Nagorno-Karabakh War, remains intact more than two months into the war. TB-2s have carried out numerous successful attacks against Russian forces, accounting for almost half of Russia's surface-to-air missiles that have been destroyed and helping to sink the Moskva, the flagship in Russia's Black Sea Fleet. Drones have also aided intelligence and reconnaissance, such as guiding Ukrainian artillery strikes. Drones have also been a major propaganda win for Ukraine, helping provide

images and video of Ukrainian strikes. Drones are perceived to be such an important part of Ukrainian success so far a song was written to celebrate the TB-2.

## **2. . . . but how relevant—and in what ways—is unclear.**

During the Nagorno-Karabakh conflict, drones operated by Azerbaijani forces were highly successful in taking out Armenian platforms. Open-source analysts attribute the destruction of 120 tanks, 53 armored fighting vehicles, 143 towed artillery pieces, and numerous other targets to Azerbaijan's TB-2s. By comparison, so far in Ukraine, the TB-2s' successful strikes have been high profile, but have destroyed only six armored fighting vehicles, five towed artillery pieces, and no tanks. But it's also not clear Ukraine needed drones to fulfill the same role as Azerbaijan. Western military powers made a tremendous effort to provide Ukraine with Javelin and other antitank missiles. Using antitank missiles instead of drones against tanks makes a lot of sense, though it also makes direct comparison with drone use in the Nagorno-Karabakh War difficult.

Ukraine's drone successes may also really just be Russian failures. Russia's military operations in Ukraine have been marked by significant problems, with its campaign plan failing to provide adequate logistics support, prepare for the stiff Ukrainian resistance, and establish air superiority, among other problems. Russia's failure to adequately counter Ukrainian drones may just be one more error to add to the list. Perhaps a better-prepared military would not have the same drone problem.

## **3. Technology and concepts alone aren't enough.**

Russia is no novice to drone warfare. Russia used and was on the receiving end of drone attacks during the conflict in Syria. Yet Ukrainian drones have still had significant impact. Sam Bendett, a leading analyst of Russian drones, notes that Ukrainian drones flew in close proximity to Russian vehicles without the counterdrone or electronic warfare protection he would expect. Perhaps Russia did not follow established doctrine around counterdrone systems. This suggests Russians soldiers simply may not appreciate the threat.

Of course, this problem is not unique to Russia. Similar dynamics may arise in other countries too, whereby soldiers who have not experienced drone warfare may discount the threat it poses. On the flipside, they may also discount the utility of their own drones. In the US Army, for example, risk aversion has been noted as a longstanding problem plaguing tactical drone use.

## **4. Targets especially vulnerable to drones must be identified.**

Even if Russia did a better job of counterdrone operations, there always will be limits. Drone detectors and interceptors have different advantages and disadvantages, and supply will always be limited just the same as any other military capability. Technological, doctrinal, and conceptual changes will also affect detector and interceptor use and success, for good and for ill. For

example, the vast majority of counterdrone systems are jammers, either severing drone command or GPS links. As drones become more autonomous and less dependent on GPS, jammers will be less effective. Even militaries that prove much more effective than Russia at counterdrone operations will have vulnerabilities.

The big, obvious question becomes this: What targets will be more or less vulnerable to drones? Answering that question is difficult. It will require the United States and allied nations to understand adversary doctrines, concepts, and technological capabilities around drone employment. The location and type of detectors and interceptors will be a big factor. Some analysis has suggested critical differences between defending static and mobile assets. This seems plausible: Static assets, especially high-value ones, might be equipped with layered sensors and interceptors to identify and counter a broad range of drone threats. Those defenses can be selected for the particular environment (e.g., if a critical building or base is near a crowded urban area, it is prudent not to rely primarily on sound-based detectors). Mobile assets will have limited organic counterdrone systems, which may have more or less value depending on when and where a drone attacks.

The United States and allied nations should also think about how they deploy and use drones to exploit those vulnerabilities. Wolf pack tactics developed for submarines in World War II might prove useful. Because drones need relatively small support infrastructure compared to manned aircraft, they can be dispersed more broadly across a theater of operation. When intelligence identifies targets vulnerable to drone strikes, multiple drones may be launched from disparate areas and converge as a group on the target. An unmanned, airborne wolf pack could include everything from simple modified commercial systems to specially designed military systems. Like submarine warfare, a wolf pack could prove particularly adept at striking vulnerable logistics convoys.

## **5. Drones are expanding the information environment.**

Social media, smartphones, and drones have helped create a virtual panopticon in the Ukraine conflict. The Ukrainian military, Ukrainian civilians, and observers around the world have built unprecedented awareness of the day-to-day conflict, capturing stories of horror and heroism. The torrent of information helps in three ways. First, the Ukrainian military monitors Russian troop movements and uses information to guide strikes. Second, there is a morale component, whereby Ukrainian military and civilians may be encouraged about the war effort. Third, the awareness provides unprecedented insight, which no doubt encourages global allies to provide diplomatic, economic, and military support.

The role drones play within the panopticon is twofold, expanding the range of sight and strengthening propaganda efforts. Even commercial drones can range miles away from the operator, providing a much broader field of view than that of a person alone. Drone also capture live images and video of events on the battlefield, which can help demonstrate the success of the

Ukrainian military. The Ukrainian government encouraged this with calls for civilians to donate their drones to the war effort.

## **6. Drone warfare isn't just for the big dogs.**

The Ukrainian military absolutely has proved its mettle against Russian forces; however, Ukraine is hardly considered a great power. Ukraine ranks fortieth in the world for defense spending, outspent by the likes of Vietnam and Kuwait. Ukraine's drone success adds evidence to broader claims that drones offer significant military capability at relatively low cost. The Armenia-Azerbaijan conflict reinforces that: Azerbaijan ranks sixtieth in defense spending, just below the Czech Republic. Drones offer relatively cheap access to airpower, and training requirements are likely far smaller than with manned aircraft, particularly because various operations can be easily automated: the TB-2 can taxi, take off, land, and cruise autonomously.

## **7. Air superiority concepts may need to be adjusted.**

There can be no doubt that Russia has struggled to establish air superiority over Ukraine. But even if Russia were far more successful, drones still complicate the picture. Flying numerous, successful high-altitude air superiority missions does not mean much for low-altitude drone threats. A commercial quadcopter isn't going to be in a dog fight with a Russian Sukhoi Su-35, but neither is that Su-35 well equipped to stop the quadcopter from carrying out an aerial attack.

Even if Russia managed to destroy every Ukrainian airstrip, drones do not need much to take off. This creates a similar challenge to man-portable air defense systems: air threats may be highly distributed, difficult to identify, and even more difficult to prevent. Air superiority concepts do not need to be thrown out, but drones add complexity to what it means to have control of the air.

In certain cases, even simple drones can create real threats to air assets. In September 2020, a hobbyist drone struck a police helicopter in Los Angeles by accident. An affidavit in the subsequent criminal case noted that a strike on the helicopter's main rotor would have brought the helicopter down. Although militaries have long tested aircraft for resilience against bird strikes, drones have much harder materials, may be flying much faster, and may carry explosives. Drones also allow for the creation of aerial minefields, in which drones fly about and autonomously target nearby aircraft. The Russian Lancet-3 loitering munition reportedly is aimed at creating such a capability.

Of course, every conflict is unique. Future conflicts will have different participants with different military capabilities and organizations, and will be fought over different territory with different strategic goals. Drone technology, concepts of operation, and counterdrone capabilities are also evolving. But the war in Ukraine is making one thing very clear: drones have a place in modern warfare and any military that hopes to achieve its battlefield objectives needs to pay attention.

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*The views expressed are those of the author and do not reflect the official position of the United States Military Academy, Department of the Army, or Department of Defense.*

## **Lessons from use of drones in the Ukraine war**

Oleg Vornik,

31 May 2022

Defense Contract

<https://www.defenceconnect.com.au/key-enablers/10094-lessons-from-use-of-drones-in-the-ukraine-war>

**Oleg Vornik, chief executive officer of DroneShield, analyses how drone and counter-drone systems have been used during the war in Ukraine.**

*Note: all information in this story comes from the various open intelligence reports, as Ukrainian military and civilian population make extensive footage with their smartphones and publishing online. This makes it the first war of its kind, fought online as much as in the field.*

Russian forces have used “grey zone warfare” (cyber, unmarked troops, Wagner Group etc.) both in Eastern Ukraine and around the globe extensively for a number of years now. Using drones is an extension of this strategy.

Drones can be used in four ways in warfare: precise payload delivery (such as dropping explosives or kamikaze attacks), surveillance (scouting out enemy positions to send a mortar or otherwise coordinate an attack), nuisance / loitering and cyber/hacking (using proximity to enemy networks to hack in via a drone and degrade/infiltrate the networks).

Drones came to symbolise asymmetric warfare, with a \$3,000 drone able to drop a charge into a \$5 million tank, destroying the tank and its occupants, without drone pilot being in the line of fire.

Russians use the following small/tactical drones:

- Orlan-10 (Special Technological Center, St. Petersburg) – most well-known drone, with reportedly over 2,000 units made;
- Eleron-3SV (Enics, Kazan);

- Granat and the Takhion (Izhmash Unmanned Systems, Izhevsk);
- Korsar (United Instrument Manufacturing Corporation, Moscow);
- Zala-421 (Zala Aero Group, Izhevsk); and
- Irkut-10 (Irkut company, Moscow).

Ukrainians also use drones, on the larger end, most famously the Turkish-supplied TB2 Bayraktar, following their success in Armenia against the Russian-supplied ground defence Pantsir systems and tanks (with Azerbaijan deploying the TB2s), as well as in the Middle East. Immediately prior to the war, Ukrainians were in the process to set up a local manufacturing line for TB2s near Kyiv. However, some of the used drones are designed and already being made locally in Ukraine too, such as:

- UKRINMASH range of drones;
- Ukrainian loitering munition ST-35 drones; and
- KB Robotics loitering munition drones.

Loitering munition drones are a fascinating class of drones on their own, essentially a low cost flying smart munitions, popularised by AeroVironment’s Switchblade, launched from a tube in the field.

The US government has recently approved supply of AeroVironment Switchblade drones to Ukraine, for use in a range of scenarios including attacking tanks.

### **And what about counter-drone/C-UAS?**

There appears to be a divide between the full-scale electronic warfare (EW) capability that Russians have, such as their on-vehicle system (which would be too much for drone jamming, too expensive to have a lot of those units and they are vulnerable targets).

And on the other hand, the handheld and portable units, which appear from public reports almost “home-made”.

Such basic jammers are likely to lack safety protocols for the operator (Russians are not well known to consider safety features for their soldiers – consider them not investing in the internal lining between the tank shell magazine and the crew, which reportedly caused a lot of the publicised tank explosions where the tower flies off some distance from the body, when a shell explodes inside the tank and creates a chain reaction with the rest of the magazine). Back in the Cold War, there is a famous story of Americans and USSR having the same class of a nuclear submarine, except the USSR boat was able to move faster ... because the lead safety wall between the crew compartment and the nuclear engine was removed from the design, to help the speed. While Western counter-drone devices go through full internationally accredited safety protocols (similar to what cellphone manufacturers do), Russian jammers are less likely to have the shielding and other design features for operator health. There is also a question of basic

effectiveness – while jammers are originally an old technology (since WWII), there is a lot of IP in waveform/antenna design, jamming signal effectiveness, effective dissipation of heat and so on.

How effective are western counter-drone systems against Russian drones? A lot of Orlan-10 components appears to be Chinese, European or US made. Hence the established C-UAS systems would likely be highly effective, both in detection and defeat. With the Russian military-industrial base likely to be plagued by years of corruption and mismanagement, use of non-Russian componentry is not surprising. Similar to their tank production lines reportedly halted due to lack of componentry.

The use of drones (and C-UAS) in warfare is here to stay – Ukraine-Russian war will be in military textbooks around the world for the next 20 years as a case study. With all the tragedy, devastation, death and loss, it is also a testbed for technologies in a military setting (first meaningful scale war for a long time). Counter-UAS systems will become a critical component for heavy armour, such as tanks and howitzers, and will form a part of the soldier portable kits (along with small tactical drones themselves).

*Oleg Vornik is the chief executive officer of DroneShield.*

## **Army Commander says upgrading Iran's drone capability unstoppable**

28 May 2022

Islamic Republic News Agency

<https://en.irna.ir/news/84770124/Army-Commander-says-upgrading-Iran-s-drone-capability-unstoppable>



Tehran, IRNA – Commander of the Iranian Army Major General Abdolrahim Mousavi said on Saturday that upgrading Iran's combat capabilities, including drone capabilities, is not stoppable by any means.

Speaking during a visit to a secret underground base for drones, Major General Mousavi said that "our biggest achievement is that we have never relied on anywhere and provided whatever we need for our defense".

He said that the launch of this secret base by the Iranian Army is in line with the main mission of the armed forces to defend the country's independence and territorial integrity.

The commander added that the need for enhancement of long-range drones with high flight resistance capacity and the high capacity of carrying ammunition for targeting strategic bases led the country to promote the capacity of the existing drones and equipping them with different types of missiles and bombs with different ranges.

## **Army unveils two new drone achievements**

28 May 2022

Islamic Republic News Agency

<https://en.irna.ir/news/84769903/Army-unveils-two-new-drone-achievements>



Tehran, IRNA - Chief of Staff of the Iranian Armed Forces Major General Mohammad Bagheri on Saturday unveiled two new drone achievements.



Major General Mohammad Bagheri visited Army's secret underground base for drones on Saturday.

During his visit, Major General Bagheri unveiled the "Heidar-1" cruise missile and "Heidar-2" cruise.



The "Heidar-1" cruise missile has a range of 200 kilometers and its speed at the moment of hitting the target is 1,000 km/h. It is the first cruise missile capable of firing from a drone.

"Heidar-2" is a UAV that is loaded on a helicopter.



## Chinese Aircraft Carrier Seen With A Fleet Of Drones On Its Deck

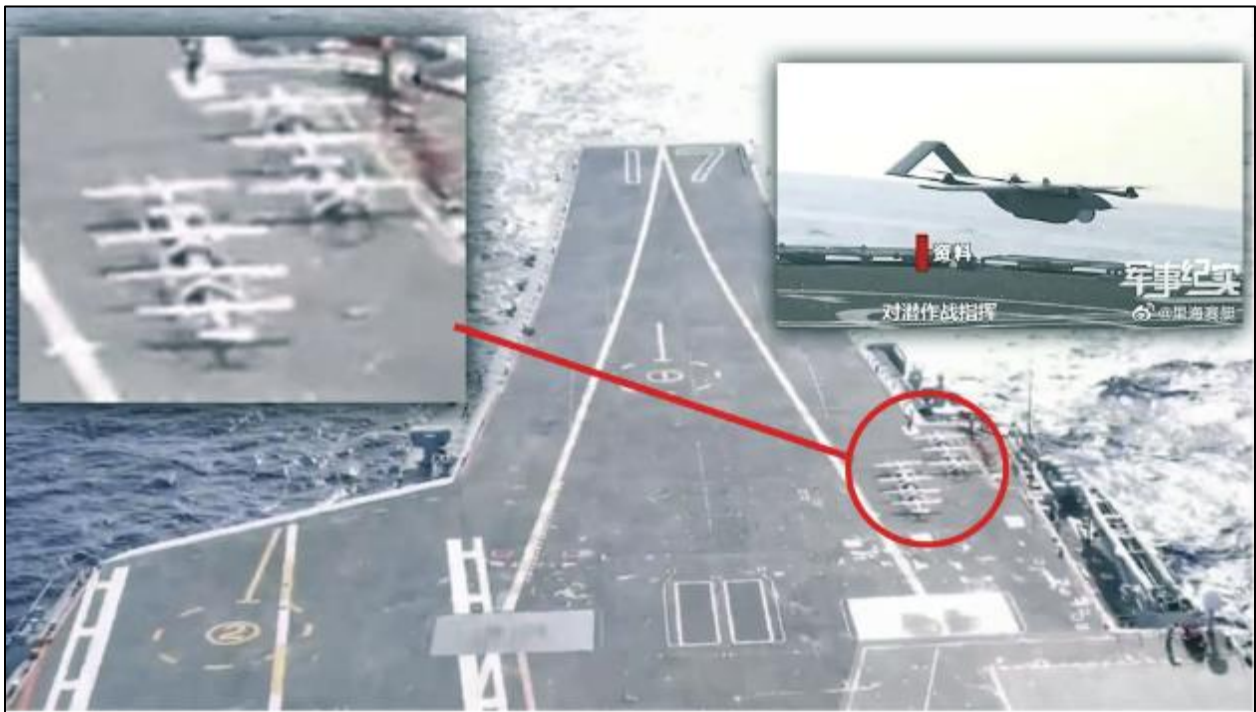
Joseph Trevithick

June 2, 2022

The War Zone

<https://www.thedrive.com/the-war-zone/chinese-aircraft-carrier-seen-with-fleet-of-drones-onboard>

Imagery shows the Chinese aircraft carrier Shandong working as a deployment platform for vertical takeoff and landing drones.



Images have emerged online that appear to show multiple examples of at least two different types of commercial or commercial-derivative drones with vertical takeoff and landing capability on the deck of the Chinese aircraft carrier Shandong. The exact circumstances behind these pictures are not immediately clear. They do underscore the Chinese People's Liberation Army's ever-increasing efforts to develop and field various types of unmanned aircraft, including those that can operate together in networked swarms, and often with an eye toward performing various roles in the maritime domain.

The images were posted recently on the Chinese microblogging website Weibo, but it's unclear when they were taken. At least one, which actually shows a drone in flight, has a CCTV-7 watermark, indicating that it is a frame from a segment that aired on that television network.

China Central Television's (CCTV) channel seven is devoted to People's Liberation Army (PLA) related programming.



In April, Chinese authorities announced that Shandong, which entered service in 2019, had started its first major scheduled maintenance period at Dalian Shipyard. Satellite imagery showed the ship still at Dalian as of at least May 26. The carrier, the first to be constructed domestically in China, had been observed transiting north through the Taiwan Strait in March, timed to coincide with a phone call between Chinese President Xi Jinping and U.S. President Joe Biden, but without any aircraft, manned or unmanned, readily visible on its deck and otherwise appearing to be headed for the shipyard.

Regardless, the pictures of the carrier loaded with these drones are significant. At least two distinct types are visible, but all of them appear to be what are often described as "hybrid" vertical takeoff and landing (VTOL) capable designs. Unmanned aircraft of this general type have relatively conventional fixed-wing configurations and operate as such in level flight, but they also have underwing booms with rotors at each end to enable VTOL operation.

In the picture showing the various drones arrayed on Shandong's deck, three of them appear to have front-mounted propellers and what may be flat t or h-tails. The other four look to have pusher propellers and twin-boom tails with inverted v connection sections. The drone in the CCTV-7-marked image also has this kind of twin-boom tail arrangement.



via Weibo

One Chinese design that could fit the general description of the front-mounted propeller types is JOUAV's CW-20, which features a gasoline-powered main engine and electrically-powered rotors for VTOL operation. The CW-20, with its nearly 6 foot long (1.8 meters) overall length and almost 10.5 foot (3.2 meters) wingspan, has a maximum takeoff weight of just over 55 pounds (25 kilograms). It has a 6-hour endurance, according to the manufacturer, and can operate just under 28 miles (35 kilometers) from the operator using a line-of-sight radio link. The company says that the standard payload is a digital still picture camera, but its website indicates that the payload bay is modular and could accommodate other systems.

JOUAV also makes various twin-boom designs that could be among the others seen on the deck of Shandong. However, the picture of the drone in flight looks like it could show a Xiang Yi CSC-005, which features an under-nose sensor turret with electro-optical and infrared cameras, as well as a laser rangefinder. Readily available information on the CSC-005 in English is limited, but it reportedly has a maximum takeoff weight of just over 46 pounds (21 kilograms) and uses a line-of-sight control link with a maximum range of around 31 miles (50 kilometers), both of which are broadly similar to the capabilities offered by the CW-20.

The low resolution of the shot of the drones on Shandong's deck and the lack of other readily available information make it hard to conclusively identify what specific drones we may be seeing in the images. There are multiple other manufacturers in China that make similar types of drones with roughly equivalent sizes and capabilities to the CW-20 and the CSC-005.

This is not the first time that China's People's Liberation Army Navy (PLAN) has been observed flying commercial or commercial derivative hybrid VTOL drones from its ships, either. In 2019, Chinese state media reported on a test involving the employment of a derivative of the Sea Cavalry SD-40, produced by a company referred to as Xiamen Hanfeiyang Aviation

Technologies and Xiamen Han's Eagle Aviation Technology, from a Type 052C destroyer. The SD-40 features a pusher propeller and twin-boom tail, but does not appear to be similar to any of the designs seen in the pictures of the drones on Shandong.

The SD-40 was specifically developed for shipboard operation and can reportedly take off and land on ships sailing in moderately rough wave states. The unmanned aircraft is just over 6.5 feet (2 meters) long and has a wingspan of around 12 feet (3.7 meters), and has a modular payload bay that can reportedly accommodate various cameras, a small radar with synthetic aperture imaging capability, or a communication relay package.

The drones we're seeing here do not represent a high-end unmanned capability. It is possible that they were on board the carrier as part of training or testing related to defending against the growing threats posed by small drones.

However, the 2019 test of the SD-40 shows that the PLAN is interested in deploying hybrid VTOL drones on ships to support non-training activities, too. There are clear potential operational benefits that these kinds of unmanned platforms might offer for an aircraft carrier such as Shandong. This could include providing overwatch around the ship against various kinds of threats or just generally providing additional situational awareness. Depending on their exact range of capabilities, they might be able to provide some degree of additional localized surveillance and reconnaissance capability for the carrier and any associated strike group. Working together, especially as part of a fully-networked swarm, the drone could sweep large areas around the ship relatively quickly.

VTOL-capable drones, even relatively small ones, could be used to carry limited amounts of cargo, including things like critical spare parts or medical supplies, to and from the carrier. The U.S. Navy experimented with using hybrid VTOL drones in exactly this role last year.

Beyond that, embarking the drones on Shandong would seem more likely than not to be a stepping stone to the broader integration of unmanned platforms, including far more capable types, such as ones that might be able to work as fully autonomous networked swarms, into PLAN carrier air wings, in general. It's no secret that the PLA as a whole, as well as China's state-run aviation industry at large, has made significant progress in recent years in the development of an extremely broad range of different and ever-more-advanced unmanned aircraft, ranging from small swarming designs to stealthy unmanned combat air vehicles (UCAV). The Chinese military has actually fielded an equally significant number of these designs, including multiple types now employed operationally in the maritime domain.

Last year, the state-owned Aviation Industry Corporation of China (AVIC) showed a computer-generated video at the most recent iteration of the country's Zhuhai Airshow that depicted navalized versions of the stealthy GJ-11 Sharp Sword UCAV taking off from a Type 075 amphibious assault ship and swarming enemy surface warships. The drones appeared to be

employing either electronic warfare suites or directed energy weapons in the video presentation, a clip of which subsequently appeared in the CCTV-7 segment seen in the Tweet below.

The PLA's interest in drone swarms, as well as ways to defend against them, including in a naval context, is well established. Last year, the Chinese launched an unusual drone carrier of sorts, ostensibly for use in training, but that could also be a step toward the operational deployment of swarms of aerial drones from various ships.

China's state-run civilian scientific and engineering enterprises, which often have clear links to the PLA, have been conducting their own work on unmanned platforms and swarming technology for use in maritime environments, as well. Just this month, the Huangpu Wenchong Shipping Company, launched a ship capable of at least semi-autonomous operation itself, which will be used as a hub for flying drones, as well as unmanned surface vessels and unmanned undersea vehicles. You can read more about the Zhu Hai Yun, which will officially be used for ocean research purposes, but that also has clear military utility, [here](#).

Shandong and the PLAN's other full-size aircraft carriers, a fleet that is expected to grow in size in the coming years, would be incredible platforms for launching and recovering massive swarms of low-end drones at sea. Experimenting now with such a concept, even with surrogate aircraft, would make some sense.

Drone swarms of various kinds are only more and more likely to be a component of future conflicts that China might find itself involved in, whether these being operated by Chinese forces or other parties. Multiple wargames conducted by or for the U.S. Air Force in recent years have shown that swarms of relatively small unmanned aircraft just operating as distributed sensor networks have provided decisive advantages for America and its allies and partners in scenarios revolving around the defense of Taiwan against a Chinese invasion.

Separately, the U.S. Navy has said on more than one occasion now that it sees its own carrier air wings have an increasing proportion of unmanned aircraft as time goes on. Drones may in fact become the dominant type of aircraft flying from America's flattops within the next few decades.

All told, whatever the specific circumstances were behind the embarking of this array of drones on China's aircraft carrier Shandong might have been, it only underscores how significant unmanned platforms are likely to be in future conflicts, including in the naval arena, and the PLA's interest in being a major force when it comes to fielding these capabilities.