Eastern promise: China grows unmanned capabilities

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China’s unrelenting drive to develop its commercial and defence aerospace capabilities has also given rise to an increasingly diverse and sophisticated range of UAV technologies. Kelvin Wong details some of the latest developments

In the 2015 iteration of its annual report on Chinese military developments to Congress, the US Department of Defense (DoD) cited estimates that China could manufacture up to 41,800 unmanned aerial vehicles (UAVs) worth about USD10.5 billion for land- and sea-based operations by 2023.

CASC’s CH-5 strike-capable UAV made its inaugural public appearance at Airshow China 2016. The existence of the company’s latest and most capable air vehicle was first revealed by state broadcaster CCTV in an August 2015 news clip. (Kelvin Wong)

The DoD also stated that the development and acquisition of longer-range UAVs would increase China’s ability to conduct long-range reconnaissance and strike operations, highlighting that new air vehicles in development in 2013 include the Xianglong (Soaring Dragon), Yilong (Pterodactyl, also known as Wing Loong), Sky Saker, and Lijian (Sharp Sword).
In its 2016 report, the DoD said that the People's Liberation Army Air Force (PLAAF) considers low-observable technologies as "integral to unmanned aircraft" - particularly for air vehicles that are expected to conduct air-to-ground attack and surveillance missions - to increase their ability to penetrate heavily protected airspace.

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**Major fixed-wing UAV developments**

While the UAVs that participated in 'Firepower 2015' were not identified by the DoD, reports from state-controlled media revealed that one of the participating UAVs had been the medium-altitude long-endurance (MALE) Wing Loong I system, which is designated the Gongji-1 (Attack-1) in PLAAF service.

![Wing Loong I UAV](image)

**AVIC is developing the Yilong I/Wing Loong II MALE UAV. Its predecessor has already entered PLAAF service, although it is not known at this stage if it plans to acquire the latest air vehicle. (Kelvin Wong)**

Developed by Aviation Industry Corporation of China's (AVIC's) Chengdu Aircraft Industry Company (CAC) subsidiary, the 1,200 kg Wing Loong I - which measures approximately 9 m long with a wingspan of 14 m - can carry a payload of up to 200 kg split evenly between internal and external stores. A 100 hp-class piston engine, reportedly an imported Rotax 914 or an equivalent system, enables the air vehicle to stay aloft for up to 20 hours.

AVIC officials confirmed to IHS Jane's that the Wing Loong I is equipped with a Loong Eye (Dragon's Eye) LE380 model electro-optical/infrared (EO/IR) turret developed by the Luoyang...
Opto-Electro Technology Development Center (LOEC). The LE380 EO/IR turret measures 380 mm in diameter and 555 mm in height, and weighs about 39 kg. The stabilised turret is capable of traversing a full 360° in azimuth and can elevate between -130° and 30°, bringing to bear a range of high-definition daylight TV cameras, thermal-imaging sensors, as well as a laser rangefinder and designator.

As a strike-capable UAV, the Wing Loong I can be armed with China North Industries Corporation's (NORINCO's) Hongjian-10 (HJ-10) air-to-surface anti-armour missiles mounted on two underwing hardpoints, as well as LOEC's 50 kg LS-6-50 small-diameter bomb. AVIC revealed a wider range of weaponry associated with the air vehicle at more recent trade exhibitions, including a three-missile launch pylon carrying the new 16 kg Tianlei-2 (TL-2) air-to-surface missile developed by the Beijing-based China Aerospace Science and Technology Corporation (CASC). NORINCO's new low-cost 50 kg CS/BBE2 high-explosive bomb was also identified as yet another compatible weapon.

The Cloud Shadow UAV bears a strong resemblance to the US-made General Atomics Predator C Avenger platform, although it appears not to possess the same level of performance. AVIC is offering armed reconnaissance and ISR variants for the export market. (Kelvin Wong)

At the Airshow China exhibition in November 2016, AVIC also unveiled its next-generation UAV developments - the Cloud Shadow and Wing Loong II. The former stands out among the field of known Chinese UAV programmes for its turbojet engine, as most indigenous developers have incorporated piston or turboprop propulsion systems due to their comparatively higher reliability and endurance.
Developed by AVIC CAC, Cloud Shadow appears to be an export derivative of its domestic Tian Yi (Sky Wing) high-altitude long-endurance (HALE) UAV development programme, which was photographed taxiing at a CAC facility in mid-2008. Unofficial imagery then depicted the Tian Yi as a medium-sized, turbojet-powered UAV with V-shaped vertical stabilisers that largely mirror the form factor of the export model.

A modified Tian Yi platform subsequently emerged in late December 2014 featuring a redesigned airframe with a wider empennage that incorporated a dual turbojet engine arrangement as well as a wider air intake. A visibly more pronounced forward fuselage that could provide additional space to install a satellite communications (SATCOM) system was also seen.

AVIC is marketing the Cloud Shadow in two configurations: an armed reconnaissance model, which has a maximum speed of 550 km/h and a payload capacity of 400 kg and six underwing hardpoints for external stores; and a dedicated intelligence, surveillance, and reconnaissance (ISR) platform, which features a higher maximum speed of 620 km/h and is optimised with a suite of communication and radar surveillance equipment, or high-altitude photo-reconnaissance systems. The company has specified a service ceiling for the armed reconnaissance variant of 45,931 ft and 49,212 ft for the ISR variants.

The armed reconnaissance and ISR variants are similarly equipped with synthetic aperture radar (SAR) for improved moving-target tracking performance, although the former carries a belly mounted EO/IR turret for target designation and post-strike battle-damage assessment (BDA).

Both platforms share the same 9 m long and 3.66 m tall airframe, which appears to draw some inspiration from the US-made General Atomics Aeronautical Systems Predator C Avenger platform. For example, the Cloud Shadow incorporates a mid-mounted wing design that spans 17.8 m and features a forward-swept trailing edge on the inboard section tapering to a constant chord outer section. However, its wings are swept back only about 10°, compared with the Avenger's more pronounced 17° sweep. Moreover, unlike its US doppelganger the Cloud Shadow is not equipped with an internal stores bay.

Cloud Shadow is also equipped with V-tail surfaces and a dorsally mounted engine pod for its propulsion system. This was revealed by AVIC to be the WP11C turbojet engine, a "modernised and refined" version of the original WP11 system developed by the Beijing University of Aeronautics and Astronautics (BUAA) for unmanned aircraft applications. AVIC officials declined to provide details of the WP11C turbojet's performance, telling IHS Jane's that it provides "significantly higher performance and reliability". The original WP11 is a reverse-engineered version of the US-made Teledyne Continental J69-T-41 system, which is rated at a maximum take-off thrust of 8.34 kN and is capable of operating at altitudes up to 59,055 ft.

Building on the domestic and export success of the Wing Loong I, AVIC has developed the larger and more capable Wing Loong II UAV, which is also designed to be a strike-capable reconnaissance platform, albeit with significantly greater payload and performance. The latest air vehicle has an overall length of 11 m, a height of 4.1 m, and a wingspan of 20.5 m, with each wing incorporating three hardpoints for external stores.

The Wing Loong II improves on the first-generation Wing Loong I platform with twice the payload capacity at 400 kg and significantly improved endurance of 32 hours. AVIC has specified a 200 km line-of-sight (LoS) command range, although this can be extended to 2,000 km by employing a SATCOM datalink.
AVIC told *IHS Jane's* that sensor payloads currently available include a chin-mounted EO/IR sensor turret with a laser rangefinder/designator and a SAR sensor. Compatible weapons include the 47 kg Blue Arrow 7 and a quad pack of 26.5 kg Blue Arrow 9 anti-armour missiles, as well as the 250 kg GB3 and 50 kg GB7 laser-guided bombs. Anti-surface missiles, such as the Blue Arrow 21 and TL-10 (also known by its export designation of YJ-9E) anti-ship missiles, also hint at a maritime attack role for the air vehicle.

Meanwhile, CASC is building on the domestic and international success of its Cai Hong 4 (Rainbow 4, or CH-4) strike-capable MALE UAV - of which a number of variants have been delivered to the PLA and countries in Central Asia and the Middle East - to compete against AVIC’s offerings with its latest CH-5 platform, which made its maiden flight in August 2015 and was unveiled to the public in November 2016.

According to the latest specifications briefed to *IHS Jane's* by a senior CASC official in November 2016, the CH-5 has a lightweight all-composite airframe structure that is 11 m long with a wingspan of 21 m. It has a maximum take-off weight (MTOW) of 3,300 kg and can carry a 1,200 kg payload, with an internal mission bay capacity of 200 kg and the remainder provisioned for underwing stores.

CASC has specified an operating range of up to 250 km via LoS datalink, although this can be extended to 2,000 km when SATCOM datalinks are available. It is also capable of autonomous flight using pre-programmed waypoint navigation, with taxiing, take-off, and landing manoeuvres also fully automated.

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**VTOL UAV developments**

Chinese firms have also unveiled a number of vertical take-off and landing (VTOL) UAV programmes within recent years. For example, privately owned Aero-Starloop High-tec Co Ltd unveiled its BH-series VTOL UAV system in late 2016. While such UAV types are widely available in domestic and international markets, the company has incorporated a highly modular design that enables operators to easily customise the air vehicle for a wide range of missions.

According to Aero-Starloop, a BH system is typically assembled from four carbon composite component modules, with a ‘main shell’ fuselage section, which houses the tail boom, power transmission mechanisms, and EO/IR sensor turret, while also providing a secure mount to attach a belly ‘oil bunker’ fuel tank module, as well as two electrical compartment units. An optional VTOL parachute rescue system (VPRS) can also be mounted on top of the rotor mast to ensure the safe recovery of the air vehicle.

"With our modular concept, we can develop new mission-specific payload modules that can be easily installed or swapped without compromising the basic performance and structural integrity of the UAV," a company spokesperson told *IHS Jane's*. "Additionally, the modular sections greatly simplify maintenance processes, and therefore potentially increase its availability for missions."

Aero-Starloop has completed the development of two variants, the BH-90 with an MTOW of 90 kg and BH-160 with an MTOW of 160 kg. According to the company, the BH-90, which has a maximum payload of 35 kg, is powered by a 20 hp HFE propulsion system that enables it to achieve a maximum speed of 180 km/h and ceiling of 14,763 ft. A 60-litre fuel tank provides up to 2.5 hours of flight endurance and an operational radius of 250 km. In contrast, the larger BH-160 is
powered by a 40 hp engine that enables it to reach speeds of up to 185 km/h and carry a 65 kg payload, while operating for up to 3.5 hours with its 100-litre fuel capacity.

Aero-Starloop High-tec Co Ltd recently introduced its modular BH-series VTOL UAV, which can be easily configured for a wide range of operations and upgraded with hot swappable propulsion and mission systems. (Kelvin Wong)

The spokesperson noted that development of the basic system has already been completed, and the company is actively seeking customers in the defence, homeland security, and commercial markets.

AVIC’s China Helicopter Research and Development Institute (CHRDI) subsidiary is developing the rotary-wing armed reconnaissance AW500W, which is essentially a weaponised variant of its civilian-model AV500 with improved performance.

According to official specifications, the AV500W has an MTOW of 470 kg with a payload capacity of 160 kg. This typically comprises a chin-mounted, stabilised EO/IR sensor turret to enable the air vehicle to perform all-weather day/night reconnaissance, BDA, and target detection and tracking. Other electronic payloads such as a SAR system and communications relay devices can be carried internally.

The air vehicle can be configured to carry a range of air-to-ground weapons on stub wings mounted on either side of its fuselage for armed interventions, with one example at Airshow China 2016 shown carrying two 6 kg-class PGM mock-ups. An AVIC official revealed to IHS Jane's that
the yet-unnamed weapon is designed to engage static or slow-moving targets up to 5 km away via SAL guidance. A 10 kg variant is also under development.

According to AVIC, the AV500W can cruise at speeds of up to 170 km/h and has maximum endurance of 8 hours when configured for reconnaissance missions. This is reduced to 4 hours when the air vehicle is outfitted with its full weapons complement. The company has also specified an operating radius of 200 km via LoS control, with a service ceiling of 13,123 ft.

The AV500W is the weaponised variant of the civilian model AV500 VTOL UAV, and is designed specifically for air-to-ground reconnaissance and strike missions. (Kelvin Wong)

IHS Jane’s understands that the AV500W is in an advanced stage of development with the production-ready design set to be finalised and the first flight expected in 2017.

Meanwhile, CASC is developing the QY-1 VTOL UAV, a militarised variant of the civilian V750. Originally developed by Weifang Tianxiang Aviation Industry Co Ltd (now known as Shenzhen Tianxiang Aviation Industry Co Ltd) as a multipurpose VTOL platform that can be employed in civilian and military applications, the QY-1 measures 6.43 m in length and 2.11 m in height. The company has also stated that the air vehicle is capable of achieving cruise and maximum speeds of 145 km/h and 161 km/h respectively, with a climb rate in excess of 23 ft/s.

According to CASC, the QY-1 has been optimised for reconnaissance, surveillance, and BDA missions with an under-nose EO/IR sensor turret, such as the 18 kg LOEC Loong Eye Model 260 system. Two stub-wing hardpoints enable the air vehicle to carry a range of lightweight munitions.
Known weapons for the air vehicle include the 25 kg FT-10 rocket-assisted precision-guided bombs, employing SAL, GPS, INS, TV, and IR guidance modes and developed by CASC’s China Academy of Launch Vehicle Technology (CALT) division, which are claimed to be capable of engaging ground targets with a CEP (circular error probable) of 1 m at a launch distance of up to 8 km.

Private firm Ziyan UAV has developed the Infiltrator armed tactical VTOL system for counter-terrorism and special operations missions. (Kelvin Wong)

A CASC spokesperson told IHS Jane’s that the prototype made its maiden flight in early 2016, with more flight and integration trials expected in 2017.

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Special purpose UAVs

While conventional fixed-wing and VTOL UAVs constitute the majority of new Chinese platforms introduced in recent years, some firms are also developing novel designs that cater to unique operational requirements.
AVIC has unveiled the Sky Wing 6 (SW-6), a dedicated surveillance or EW UAV payload. The mini-UAV features a flattened 1.6 m-long fuselage designed to enable the 2.4 m-long forward (upper) and 2.9 m-long rear (lower) wing surfaces to be folded for carriage in an aircraft’s internal mission bay or external hardpoints.

The SW-6 has an MTOW of 20 kg and is equipped with a 5 kg payload bay in its nose. This typically comprises a high-definition CCD daylight camera or an IR imager as well as a two-way datalink to stream data to a nearby ground-based terminal. In its EW configuration, the SW-6 can be equipped with a range of single or multiband RF jamming packages.

According to an AVIC spokesperson, the air vehicle is designed to be deployed from a carrier aircraft at an altitude of around 6,560-9,840 ft, to enable its wings to unfold fully and for it to glide itself to its cruising altitude of 3,280 ft. An electric motor enables it to cruise at speeds of 80 to 100 km/h, while a lithium-ion battery provides a flight endurance of 1 hour and provides power to its camera or EW payload.
The SW-6 air-deployable mini surveillance/electronic warfare UAV shown in its transport configuration as an air-launched payload from a Z-11WB reconnaissance and light attack helicopter. (Kelvin Wong)

Chengdu-based China Electronics Technology Corporation's (CETC's) Special Mission Aircraft System Engineering division is developing the Mysterious Bee fixed-wing VTOL UAV, which appears to be modelled after comparable Western systems such as the Arcturus JUMP family and Autel Kestrel.
Defence prime China Electronics Technology Corporation recently unveiled its Mysterious Bee fixed-wing VTOL platform. It can perform high-speed conventional flight as well as hover for improved operational flexibility. (Kelvin Wong)