UMANNED AERIAL VEHICLES

AN ARMADA INTERNATIONAL COMPENDIUM SUPPLEMENT

2018/19

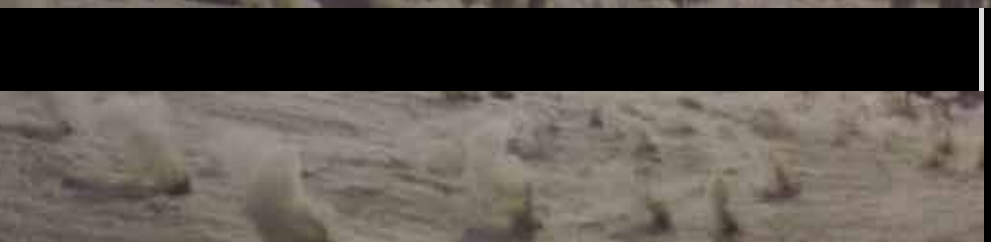
ORBITER 4
Small Tactical UAS

Ahead of Time

ORBITER 3
Small Tactical UAS

PEGASUS 120
Tactical VTOL UAS

ORBITER 1K
Loitering Munition UAS



Aeronautics Group
Ahead of Time
www.aeronautics-sys.com

USAF

An US Air Force MQ-9 Reaper equipped with an extended range modification sits on the ramp on Kandahar Airfield, Afghanistan, December, 2015, before a sortie.

UNMANNED UNLEASHED

While the technologies continue to mature, UAV's have entered the mainstream of military equipment.

Peter Donaldson

The Teal Group predicts a vigorous growth in the production of Unmanned Aerial Vehicles (UAVs) driven by worldwide military adoption of UAVs alongside a soaring demand for the next generation of Unmanned Combat Aerial Vehicles (UCAVs) over approximately the next decade.

In its most recent market study published in November 2017, the company estimated an increase in the dollar value of annual UAV production from $4.2 billion in 2017 to $10.3 billion in 2026 for a total spend of around $80.5 billion over the period, adding that military research spending on the sector would increase that total by $26 billion.

"Increasing trade in costly high-altitude, long-endurance systems, demand for armed UAVs, the development of the next generation of unmanned combat systems, and potential new applications such as missile defense continue to drive the market", said Philip Finnegan, Teal Group's director of corporate analysis and one of the study's authors.

Co-author Steve Zaloga revealed that they expect the United States (US) to account for 57 percent of total Research, Development, Test and Evaluation (RDT&E) on the technologhy worldwide and about 31 percent of military procurement. He added that the relative strength of the US market comes from the focus on larger, high value systems, although in other areas, such as Asia-Pacific, growth is more rapid.

In its own study published in April, Global Market Insights (GMI) broadly concurs with Teal's expectations, estimating the value of the world market at $5 billion in 2016, although it expects annual market value to reach $13 billion a little sooner in 2024. While military UAV fleets are growing around the world, the US still operates around 70 percent of them, according to GMI, adding that military applications accounted for over 85 percent of the industry's revenue in 2016, and that rotary wing UAVs took more than 65 percent of the revenue in that year.

Naval crewmen launch an unmanned aerial vehicle aboard Mark VI patrol boat during a training exercise in the Pacific Ocean, 19 June, 2018.

VIGOROUS GROWTH

GMI predicts a Compound Annual Growth Rate (CAGR) of more than 12 percent over the 2017 to 2024 period, and a fleet size of more than 18,000 units by the end of the period, although it wasn't clear whether units means individual aircraft or UAV systems, which may include several airframes. On a regional note, the Asia Pacific market is expected to show a CAGR of around 17 percent for the period.

Other expected trends, according to GMI, include a CAGR in the market for hybrid UAVs (those that combine vertical take-off and landing with fixed-wing cruise capabilities) of more than 15 percent, and a CAGR of over 18 percent for autonomous UAVs.

The attraction of VTOL capability is obvious, particularly if vehicles can take off and land automatically, as it means that UAV systems can be operated from confined areas and positions of concealment more easily, making the whole launch and recovery procedure more simple and using a smaller operational footprint. As with manned aircraft, however, VTOL capability always comes with speed, range and payload penalties.

Various kinds of hybrid solutions are coming onto the market many of which combine a propeller driven by an internal combustion engine of some kind for cruise flight with four or more vertically positioned propellers for the VTOL portion of the flight. More advanced and complicated designs resort to solutions such as tilting wings, rotors or propellers and even tail sitter configurations to minimise the payload penalty imposed by carrying an extra propulsion system that is not used for most of the mission.

The reference to autonomous UAVs is little vague, however, as there are degrees of autonomy and most vehicles in production today can fly pre-programmed routes following waypoints and implement emergency procedures for loss of communications or electrical power, for example, automatically, while more advanced capabilities such as sense and avoid, swarming and task prioritisation are under development. Autonomy, the organisation notes, is an increasingly important market driver.

BVLOS FOCUS

Other predictions for the period include a market share of more than 67 percent for drones capable of operating at Beyond Visual Line Of Sight (BVLOS) ranges, and the capture of more than half the market by vehicles with Maximum Take-Off Weight (MTOW) figures between 25kg and 150kg.

Larger vehicles are also expected to increase in importance, with a CAGR of around 11 percent expected over the period for those with payloads of 150kg or more.

While the bulk of UAV missions remain centred on Intelligence, Surveillance and Reconnaissance (ISR), armed ISR and other combat roles are also established realities, both among nation state militaries such as those of the US, the UK and Israel in particular, and non-state actors, with Daesh, for example, having successfully adapted commercially available drones to drop mortar bombs, modified rifle grenades and other improvised munitions.

The value of UAVs for ISR missions continues to grow with advances in sensor technologies from electro-optics to radar and electronic intelligence and support, and with improvements in machine learning algorithms and artificial intelligence that help operators and analysts draw actionable information from flood of data to support military commanders in their decision making.

The emphasis on border patrol and security missions is growing as many nations continue to militarise their borders to keep out would-be immigrants and refugees and the small minority of terrorists and criminals who might hide among them. Maritime patrol missions are also growing in importance for the previous reasons in addition to the more normal need to protect assets in Exclusive Economic Zones.

Wide area coverage and missions lasting many hours tend to be the preserve of High Altitude Long Endurance (HALE) and Medium Altitude Long Endurance (MALE) UAVs, which are large vehicles comparable in size to manned aircraft. However, there is also growth at the other end of the scale exemplified by the FLIR Systems Black Hornet nano-UAV, a mini-rotorcraft small enough to sit on the palm of the hand, whose range of 2km and endurance of 25 minutes is a good match for the round-the-corner, through-the-door, or behind-the-barn ISR needs of dismounted infantry and special forces.

GROUP LOGIC

Between the extremes of HALE UAVs such as Northrop Grumman's Global Hawk and nano devices like the Black Hornet, are other categories such as – starting at the small end – mini, small tactical, tactical, and MALE, with naval VTOL systems and developmental UCAVs in categories of their own. While the US industry uses these categories, in parallel the military has always had its own taxonomy, which used to be based on a 'tier' system but has been changed to a system for five groups based on combinations of Maximum Gross Take-Off Weight (MGTOW), operating altitude and speed.

Group 1 covers vehicles up to 20lb (9.07kg) in MGTOW, with operating altitudes up to 1,200ft (366m) Above Ground Level (AGL) and would therefore cover nano-, micro- and mini-UAVs up the size of the AeroVironment Raven and Wasp for example.

The equivalent numbers for Group 2 are 21-55lb (9.5-25kg), 3,500ft (1,067m) in altitude and under 250kt, with examples including the Boeing Insitu ScanEagle.

Group 3 encompasses UAVs comparable

to the AAI RQ-7B Shadow, the Boeing Insitu RQ-21B Blackjack and the NASC RQ-23 Tigershark, with weights between 55lb and 1,320lb (599kg), operating altitudes up to 18,000ft and the same speed range as Group 2.

Group 4 vehicles way more than 1,320lb (599kg), but operate in the same altitude band as their Group 3 counterparts but without restrictions on airspeed in the definition. Group 4 includes the Northrop Grumman MQ-8B Fire Scout, General Atomics' MQ-1A/B Predator and MQ-1C Gray Eagle.

Finally, Group 5 UAVs weigh more than 1,320lb, typically operate at altitudes above 18,000ft (m) at any airspeed, with examples including the General Atomics MQ-9 Reaper, Northrop Grumman RQ-4 Global Hawk and MQ-4C Triton.

UAVS DOMINATE US UNMANNED SPENDING

The US is expanding its spending on unmanned systems of all kinds and associated technologies, but airborne systems are still dominant in the Department of Defense's (DOD) budget request for the Financial Year 2019 (FY19). The DoD wants about $9.39 billion which includes funding for nearly 3,500 new unmanned air, ground and maritime vehicles, up from around $7.5 billion in the FY18 request.

In the FY19 request, UAV systems account for $6.45 billion, with maritime systems coming next at $982 million, then investment in technologies related to autonomous capabilities including teaming and swarming at $866 million, and ground vehicles at $429 million. Acknowledging the capabilities of adversaries, potential and real, the DoD also wants to spend over $1 billion on counter-drone technologies, including a shipboard laser.

Among highlights selected by Dan Gettinger in a report published in April by the Center for the Study of the Drone at Bard College was a request to fund 1,618 AeroVironment Switchblade loitering munitions. Switchblade is an example system that blurs the line between UAVs and guided missiles. Gettinger also noted that funding for the USAF's MQ-9 Reaper programme remains the single largest unmanned systems item in the budget request which grew by more than $200 million to $1.44 billion, and that a boost of more than $500 million for R&D on the MQ-25 Stingray carrier borne unmanned aerial refuelling aircraft is the single biggest contributor to the overall increase in DoD spending. He also noted that the Pentagon has requested increased funding for an artificial intelligence effort known as Project *Maven* as well as funding for new research into autonomy and artificial intelligence.

Beyond the west, the Indian Army began the process in November 2017 of tendering for 600 mini-UAVs for infantry battalions tasked with monitoring its borders with Pakistan and China.

In its market report, GMI noted that China accounts for more than 50 percent of the market for UAVs in the Asia Pacific region, driven by major investments by the Chinese Government, which is focused on growing its domestic research, development and production capabilities. Production of the CH-5 Rainbow system, an approximate equivalent of the MQ-9 Reaper that, says GMI, costs about half as much as the US vehicle.

Dull, dirty and dangerous missions remain the bread and butter of UAV systems, but the scope of those missions is expanding, and the world's militaries are keen to push the envelope of their capabilities.

AERONAUTICS LTD

ORBITER 2

Length: 1m
Span: 3m
Maximum take-off weight: 10.3kg
Range: 100km
Speed: 70kts
Endurance: 4hr
Altitude: NA
Payload: 1.5kg
Controp stabilised payloads including D-STAMP day EO, UZ-STAMP night, M-STAMP: dual day and night and Rafael HD-Lite photogrammetric mapping & 3D modelling sensor. In service in Israel and export customers inc Finland.
Powerplant: Electric motor driving pusher propeller
Launch/Recovery: cat/para

ORBITER 3

Length: NA
Span: 4.4m
Maximum take-off weight: 30kg
Range: line of sight up to 150km
Speed: 70kts
Endurance: 7hr 100km from base
Altitude: NA
Payload: 5.5kg
Payloads include: Controp T-STAMP tri-sensor stabilized EO system, D-STAMP day turret, UZ-STAMP night, M-STAMP dual day and night, and Rafael HD-Lite photogrammetric mapping sensor. In service with Israel & export customers.
Powerplant: Propeller driven by an electric motor
Launch/Recovery: Cat/net

AEROSTAR

Length: 4.5m
Span: 8.7m
Maximum take-off weight: 230kg
Range: 250km
Speed: 110kts
Endurance: 12hr
Altitude: NA
Payload: 50kg
Options include stabilized EO/IR sensors, laser designation, synthetic aperture radars with ground moving targe indication, ELINT and COMINT systems. Customers include: Israel, General Dynamics, CIS, the Netherlands & Poland.
Powerplant: Zanzottera fuel injected 2-str twin, 38hp
Launch/Recovery: conv/conv

DOMINATOR

Length: 8.55m
Span: 13.5m
Maximum take-off weight: 1,910kg
Range: LOS 300 km, BLOS satcom unlimited
Speed: 150kts
Endurance: > 20hr
Altitude: 18,000ft
Payload: 373kg
Options include EO/IR and hyper-spectral sensors with laser pointer and designator, maritime radar, SAR\GMTI radars, communications relays, COMINT, ELINT, MAD etc. Operators include Mexico & Turkey.
Powerplant: 2 x 170hp Austro AE300 jet fuel piston engines
Launch/Recovery: conv/conv

AIRBUS

HARFANG

Length: 9.3m
Span: 16.6m
Maximum take-off weight: 1,250kg
Range: 1,000km
Speed: 110kts
Endurance: 12hr at 550nm (1,019km) from base
Altitude: 25,000ft
Payload: 250kg
Synthetic aperture radar wtih 1 m resolution, Wide-Area Surveillance (WAS) & spot modes, EO/IR turret also with WAS & spot modes, NATO-STANAG-3875-compliant laser designator, panoramic pilot assistance camera. Ex-French systems acquired by Royal Moroccan Air Force.
Powerplant: 115 hp turbocharged Rotax 914 piston engine
Launch/recovery: conv/conv

PBS Velka Bites / UAV engine producer

PBS TJ150

1,500 N
19.6 kg
ø 272 mm

PBS TJ100

1,300 N
19.5 kg
ø 272 mm

PBS TJ80

900 N
12 kg
ø 235 mm

PBS TJ40

395 N
3.3 kg
ø 147 mm

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ATLANTE

Length: 5.47m
Span: 8.0m
Maximum take-off weight: 570kg
Range: 200km on datalink
Speed: 108kts
Endurance: > 10hr
Altitude: 20,000ft
Payload: 100kg
Retractable HD EO/IR turret as standard, SAR/GMTI, maritime radar, environmental sensors including releasable types are options.
Powerplant: 1 x internal combustion engine
Launch/recovery: conv/conv or cat/para


KZO

Length: 2.25m
Span: 3.42m
Maximum take-off weight: 161kg
Range: 140km (on data link
Speed: 118.8kts
Endurance: 5.5hr
Altitude: approx 11,500ft
Payload: 35kg
Thermal imager system (8–12 µm or 3–5 µm), 3 x fixed-focus TV cameras (6 FoV). Principal operator is the German Army.
Powerplant: 24 kW 2-str engine
Launch/recovery: rato, cat/para


ZEPHYR S

Length: 7.5m est
Span: 25m
Maximum take-off weight: < 75kg
Range: > 18,500km est
Endurance: > 30 days
Altitude: > 65,000ft
Payload: 5kg
HD Optical / IR Video, AIS, Narrowband mobile comms (e.g. Tetra), 100 Mpbs broadcast
Powerplant: Solar powered electric motors
Launch/recovery: conv/conv


ZEPHYR T

Length: 6m est
Span: > 32m
Maximum take-off weight: 140kg
Range: > 18,500km est
Speed: approx 30kts
Endurance: > 45 days
Altitude: > 65,000ft
Payload: 20kg
RADAR, LIDAR, ESM/ELINT, Broadband Comms
Powerplant: solar powered electric motors
Launch/recovery: conv/conv

AEROVIRONMENT


PUMA AE

Length: 4.6ft (1.4m)
Span: 9.2ft (2.8m)
Maximum take-off weight: 14lbs (6.3kg)
Range: 20km
Speed: 25-45kts
Endurance: > 3hr
Altitude: 500ft AGL
Payload: > 0.85kg
Mantis i45 turret, 360° pan, +10° to -90° tilt, stabilized EO, IR camera, and IR Illuminator in one modular payload. Operators include Belgian, Egyptian and US Armies, USAF, USMC, USN, NOAA
Poweplant: battery electric
Launch/recovery: hand or rail/deep stall landing

RAVEN

Length: 0.9m
Span: 1.4m
Maximum take-off weight: 1.9kg
Speed: 17-44kts
Endurance: 60 to 90min
Altitude: 500ft
Poweplant: battery electric
Payload: 0.17kg
Dual forward and side-looking EO or IR camera nose with electronic pan-tilt-zoom and stabilisation.
Most are operated by the US, but foreign customers have included Australia, Estonia, Italy, Denmark, Spain and the Czech Republic.
Launch/recovery: hand/deep stall landing

SNIPE NANO QUADCOPTER

Length: < 200mm est
Span: < 300mm est
Maximum take-off weight: 0.14kg
Range: > 1km
Endurance: > 15min
Speed: 19kts
Altitude: > 30m
Powerplant: battery electric
Payload: NA
EO/IR camera
Launch/recovery: VTOL

SWITCHBLADE LOITERING MUNITION

Length: < 0.6m est
Span: < 0.925m est
Maximum take-off weight: < 2.5kg
Range: 10 to 45km
Endurance: 10min
Speed: 55-85kt
Altitude: < 500ft AGL
Payload: NA
Dual front and side look EO cameras and IR nose camera. Stabilised electronic pan-tilt-zoom, Orbital ATK advanced munition warhead. US Army and USMC are the primary users.
Powerplant: battery electric
Launch/recovery: tube/NA

BLACKWING

Length: 0.508m
Span: 0.69m est
Maximum take-off weight: 1.8kg
Range: 10 to 45km
Speed: 87kts
Endurance: 1hr est
Altitude: < 500ft AGL
Payload: NA
Front and side look day/night cameras, tactical data relay.
Major order from the US Navy reported in October 2017 with final deliveries due in November 2018.
Powerplant: battery electric
Launch/recovery: Underwater-to-air delivery canister, multi-pack

WASP AE

Length: 0.76m
Span: 1.02m
Maximum take-off weight: 1.3kg
Range: 5km LOS
Speed: 20-45kts
Endurance: 50min
Altitude: 500ft AGL
Payload: NA
Gimbaled payload with pan and tilt stabilized high resolution EO & IR camera in a compact aerodynamic modular payload. Serves with US Army and export customers including Australia.
Powerplant: battery electric
Launch/recovery: hand, remote/deep stall landing

ARCTRUS

T-20

Length: 2.87m
Span: 5.33m
Maximum take-off weight: 84kg
Range: NA
Speed: 75kts
Endurance: 20hr
Altitude: 15,000ft
Payload: 34kg inc fuel
Cloud Cap Technologies 200 and 400 Series EO/IR are standard options. 3-D mapping, SAR, LIDAR, communications relay, COMINT, and SIGINT systems are available. Operators include the US & Mexican navies & reportedly the Turkish government.
Powerplant: 1 x 190 cc fuel-injected Honda 4-str petrol
Launch/recovery: cat/belly

JUMP 15

Length: 1.8m
Span: 3.3m
Maximum take-off weight: 24kg
Range: NA
Speed: 55kts
Endurance: > 6hr
Altitude: NA
Payload: NA
Powerplant: piston engine & propeller for cruise, 4 x electric motors and propellers for VTOL, electric cruise engine available
Launch/recovery: VTOL

JUMP 20

Length: 1.13m
Span: 2.22m
Maximum take-off weight: 95.25kg
Range: 125 km
Speed: 72kts
Endurance: 9 to 16hr
Altitude: 15,000ft
Payload: 27.2kg inc fuel
Cloud Cap Technologies 200 and 400 Series EO/IR are standard options. 3-D mapping, SAR, LIDAR, communications relay, COMINT, and SIGINT systems are available.
Poweplant: 1 x Engine 190cc 4-str engine & 4 x electric motors and props for VTOL
Launch/recovery: VTOL, cat launch option

ARMENIAN ARMED FORCES

KRUNK

Length: 3.8m
Span: 5m
Maximum take-off weight: NA
Range
Speed: 82kts
Endurance: 5hr
Altitude: 15,770ft
Payload: 60kg
Operators include the Armenian armed forces, the Republic of Artsakh and Denmark
Powerplant: Internal combustion enging driving pusher propeller
Launch/recovery: conv/conv (wheels)

BLUEBIRD AERO SYSTEMS

MICROB

Length: 1.02m
Span: 1.7m
Maximum take-off weight: 2.2kg
Range: 10km
Speed: 40kts cruise, 54kts max
Endurance: 1 to 2hr
Altitude: 3,281ft
Payload: 0.3kg
Dual sensor (CCD / Uncooled IR) Gimbaled and stabilized surveillance payload
Powerplant: brushless electric motor, rechargeable battery
Launch/recovery: shoulder-fired launcher/para

SPYLITE

Length: 0.135m
Span: 0.275m
Maximum take-off weight: 9.5kg
Range: 50km
Speed: 32-65kts
Endurance: 4hr
Altitude: 3,281ft
Payload: NA
Single HD, dual or triple CCD, IR and optional laser pointer gimbaled and stabilized payloads and/or optional high resolution, proprietary RGB/multi-spectral/radiometric photogrammetric payloads for mapping
Powerplant: battery electric
Launch/recovery: auto cat/para, airbag

WANDERB

Length: 0.132m
Span: 0.3m
Maximum take-off weight: 13kg
Range: 50km
Speed: 32-65kts
Endurance: 6 or 10hr
Altitude: 3,281ft AGL
Payload: NA
Optional proprietary RGB, multi-spectral or IR photogrammetric payloads for mapping
Poweplant: battery or fuel cell and electric motor driving propeller
Launch/recovery: cat/para airbag

THUNDERB

Length: 0.19m
Span: 0.4m
Maximum take-off weight: 28kg
Range: 100km
Speed: NA
Endurance: 16 to 24hr
Altitude: 3,281ft
Payload: 3.5kg
Up to 3.5 kg – nose mounted with full fuel. Additional payload capacity in the fuselage with fuel trade-off. Dual or triple CCD, IR and optional laser pointer gimbaled and stabilized payloads and/or optional high resolution gimbaled and stabilized scanning photogrammetric payload
Powerplant: piston engine with electronic fuel injection
Launch/recovery: auto cat/para airbag

BOEING DEFENCE, SPACE AND SECURITY

UNMANNED LITTLE BIRD H-6U

Length: 9.94m
Span: 8.38m
Maximum take-off weight: 1,497kg
Range: 430km
Speed: 145kts
Endurance: 6hr
Altitude: 20,000ft
Payload: 635 kg unmanned, 544 kgmanned
Powerplant: Rolls-Royce model 250 turboshaft
Launch/recovery: VTOL

BOEING INSITU

SCANEAGLE

Length: 1.6m
Span: 3.1m
Maximum take-off weight: 22kg est
Range: > 100km LOS
Speed: 50-60kts cruise, 80kts max
Endurance: > 24hr
Altitude: 19,500ft
Payload: 3.4kg
EO, EO900 (EO camera and EO telescope), MWIR, Dual Imager (EO and MWIR)
Operated by USAF, USMC, USN and numerous export customers.
Powerplant: Obital 2-str heavy fuel (JP-5 or JP 8) 2-str engine or C-10 gasoline engine
Launch/recovery: cat/SkyHook

SCANEAGLE 2

Length: 1.71m
Span: 3.11m
Maximum take-off weight: 26.5kg
Range: NA
Speed: 50-60kt cruise
Endurance: 18hr
Altitude: 19,500ft
Payload: 5kg
Powerplant: Orbital Argon heavy fuel (JP-5 or JP-8) 2-str piston engine
Launch/recovery: cat/SkyHook vertical wire

SCANEAGLE 3

Length: 2.3 to 2.5m
Span: 4m
Maximum take-off weight: 36.3kg
Range: NA
Speed: 80kt
Endurance: 18hr
Altitude: 20,000ft
Payload: 9.1kg
Turret houses EO, EO900 (EO camera and EO telescope), MWIR, Dual Image EO and MWIR)
Powerplant: 1 x 2-str heavy fuel piston enging burning JP-5/JP-8
Launch/recovery: cat/SkyHook vertical wire

BLACKJACK

Length: 2.5m
Span: 4.9m
Maximum take-off weight: 61kg
Range: NA
Speed: > 90kts
Endurance: >16hr
Altitude: > 20,000ft
Payload: 17.7kg
EO imager with 1.1°–25° optical field of view & 4x digital zoom, mid-wave infrared imager with 2°–25° field of view, laser rangefinder, IR marker. Communications relay and AIS also integrated.
Powerplant: 8 HP Orbital reciprocating engine with EFI, burning JP-5, JP-8 heavy fuels
Launch/recovery: cat/SkyHook vertical wire

INTEGRATOR

Length: 2.5m
Span: 4.8m
Maximum take-off weight: 61.2kg
Range: NA
Speed: 55kts cruise, 90kts max.
Endurance: >24hr
Altitude: . 19,500ft
Payload: 18kg
Baseline package includes EO imager, mid-wave infrared imager, IR marker laser rangefinder
Powerplant: Orbital 2-str heavy fuel piston engine burning JP-5/JP-8
Launch/recovery: cat/SkyHook vertical wire

CATIC

ASN209

Length: 4.273m
Span: 7.5m
Maximum take-off weight: 320kg
Range: 200km
Endurance: 10hr
Speed: 97kts
Altitude: 16,000ft
Payload: 50kg
Powerplant: Internal combustion engine driving pusher propeller
Launch/recovery: rocket booster/para

DENEL DYNAMICS

SEEKER 400

Length: 5.77m
Span: 10m
Maximum take-off weight: 450kg
Range: 250km
Speed: 81kts
Endurance: 16hr
Altitude: 18,000ft
Payload: 100kg
Powerplant: 1 x 85hp two-cylinder, air-cooled 4-str engine
Launch/recovery: conv/conv

ELBIT

HERMES 90

Length: approx 3.5m
Span: 5m
Maximum take-off weight: 125kg
Range: 150km mission radius
Speed: 95kts
Endurance: 15hr
Altitude: 15,000ft
Payload: 30kg
Options include EO/IR/laser, COMINT, large area scanning payloads
Powerplant: 1 x internal combustion engine
Launch/recovery: cat/wire arrestor or conv/conv

HERMES 450

Length: approx 5.7m
Span: 10.5m
Maximum take-off weight: 550kg
Range: 300km
Speed: 95kts
Endurance: 17hr
Altitude: 18,000ft
Payload: 180kg
Options include EO/IR, SAR/GMTI & maritim patrol radars plus AIS, ELINT, EW, COMINT, COMJAM. Forms the basis of the UK/Thales WK450 Watchkeeper system.
Powerplant: 1 x 52hp UAV Engines R802/902 rotary
Launch/recovery: conv/conv

HERMES 900

Length: 8.3m est
Span: 15m
Maximum take-off weight: 1,180kg
Range: 2,500km est
Speed: 60kts cruise, 119kts max.
Endurance: 30 to 36hr
Altitude: 30,000ft
Payload: 350kg
Options include Leonardo Gabianno T-200 maritime & SAR/GMTI radar, AIS, Elbit D-CoMPASS EO/IR/Laser turret, AES 210 V – ESM/ELINT, Skyfix / Skyjam – COMINT/DF & optional COMJAM system and a communications relay. Users include the Israeli Air Force, with exports to Azerbaijan, Brazil, Chile, Colombia, Mexico and Switzerland reported.
Powerplant: 1 × 115hp Rotax 914 4-str engine
Launch/recovery: conv/conv

SKYLARK I-LEX

Length: 1.5m est
Span: 3m
Maximum take-off weight: 7.5kg
Range: 40km LOS
Speed: 35kts est
Endurance: 3hr
Altitude: 15,000ft
Payload: 1.2kg
Stabilized EO/IR turret, delivering high-quality day and night real-time video. Advanced image processing capabilities include tracker, moving target indicator, geo-registration, and mosaicing.
Powerplant: battery electric
Launch/recovery: hand/stall-airbag

SKYLARK 3

Length: 2.6m (est) Span: 4.7m
Maximum take-off weight: 40kg Range: 100km
Endurance: 6hr Speed: 35kts
Altitude: 15,000ft Payload: NA
Dual payload - high resolution EO/IR gimbal is standard, options include ELINT and COMINT
Powerplant: battery electric, two-blade pusher propeller
Launch/recovery: cat/stall, airbag

SKYLARK C

Length: 1.3m est Span: 3.6m
Maximum take-off weight: 15kg Range: 40km
Speed: NA EnduranceL 7hr
Altitude: 15,000ft Payload: NA
Dual payload – cutting edge technology EO/IR, gimbaled and stabilized
Powerplant: battery & electric motor driving pusher propeller
Launch/recovery: cat on vessel/para to water landing

DA VINCHI (SMALL MULTI-ROTOR)

Length: NA Span: NA
Maximum take-off weight: 15kg Range: 10km
Speed: NA Endurance: 1hr 30min
Altitude: 30 to 1,500ft Payload: 5.6kg
EO/IR dual-sensor stabilised camera turret
Powerplant: battery and four electric motors driving vertical propellers
Launch/recovery: VTOL

THOR

Length: NA Span: NA
Maximum take-off weight: 12.5kg Range: 10km
Endurance: 75min Speed: 35kts max
Altitude: 10 to 2,000ft Payload: 1.5kg
Lightweight dual EO/IR stabilised camera turret
Powerplant: battery & 4 x electric motors driving vertical props
Launch/recovery: VTOL

NOX

Length: NA Span: NA
Maximum take-off weight: 5kg Range: 4km
Endurance: 55min Speed: 27kts
Altitude: 10 to 1,500ft Payload: 0.7kg
A a range of EO and high resolution cameras is available
Powerplant: battery & 3 x electric motors driving vertical props
Launch/recovery: VTOL

ENICS

ELERON-3SV (T-28 AIR VEHICLE)

Length: 0.635m
Span: 1.47m
Maximum take-off weight: 5.5kg
Range: 25 to 50km
Endurance: 1 hr 40min
Speed: 38-70kts
Altitude: 16,404ft
Payload: NA
Option 1: 3-axis stabilised turret with a 10x optical magnification-enabled video camera and digital photo camera with minimum 10.2 mpix resolution.
Option 2: Stabilised turret with 10x thermal imaging and video camera. Digital camera with minimum 10.2Mp resolution.
Powerplant: battery & 1 x electric motor driving pusher propeller
Launch/recovery: cat/para

ELERON-10SV (T-10 AIR VEHICLE)

Length: 0.883m
Span: 2.206m
Maximum take-off weight: 15.5kg
Range: 50 to 60km
Endurance: 2 hrs 30min
Speed: 41-73kts
Altitude: 13,123ft
Payload: NA
Option 1: 3-axis stabilised turret with a 36x optical magnification video camera, plus a 10 mpix digital camera
Option 2: 3-axis stabilised turret with an uncooled thermal imager and a video camera, plus a 10 mpix digital camera
Powerplant: battery & electric motor driving pusher propeller
Launch/recovery: cat/para

EMT INGENIEURGESELLSCHAFT

LUNA

Length: 2.36m
Span: 4.17m
Maximum take-off weight: 40kg
Range: > 100km
Endurance: 6 to 8hr
Speed: 38kts cruise
Altitude: 16,400ft
Payload: NA
1 x colour video CCD pilot view camera; wing ice monitoring camera, 3-axis stabilized modular sensor platform, downward looking colour video (zoom) CCD cameras as standard. Optional sensors: MWIR imager, near-IR CCD zoom video cameras. Serves with the German Army.
Powerplant: 2 cylinder 2-str internal combustion engine, pusher propeller
Launch/recovery: cat/para or net

LUNA NG

Length: 3.0m
Span: 5.3m
Maximum take-off weight: 110kg
Range: > 100km
Endurance: > 12hr
Speed: 49kts
Altitude: > 16,400ft
Payload:
Steerable, stabilised HD optical, infrared and hyperspectral cameras, SAR/GMTI radar. Options: Chem, bio, nuclear sensors, ESM, COMINT, radio relay, transponder. Purchased by the German Army.
Powerplant: 1 x 13.4 hp, fuel-injected multi-fuel engine
Launch/recovery: cat/para or net

MUSECO

3.2m
Span: 3.5m (rotor dia)
Maximum take-off weight: 125kg
Range: > 100km
Speed: NA
Endurance: 3hr
Altitude: NA
Payload:
Tiltable sensor platform with up to seven cameras inc colour zoom and IR zoom video, arrays, turrets, high-definition, hyperspectral, forward looking pilot colour video. Synthetic aperture radar, SIGINT-sensors, CBRN-sensors. Comms relay optional.
Powerplant: 40hp heavy fuel turboshaft driving 3-blade main roto, 2-blade tail rotor
Launch/recovery: VTOL

ALADIN

Length: 1.57m
Span: 1.46m
Maximum take-off weight: < 4kg
Range: > 15 m
Endurance: > 1hr
Speed: 22-38kts
Altitude: 328 to 984ft
Payload:
Daylight: 4 x colour CCD video cameras: 1 pilot view, 2 x downward looking, 1 downward looking on left side used in circling mode, plus high-res forward looking zoom camera, 2 x daylight video cameras. Night: 1 x IR video, 1 x colour video CCD camera
Powerplant: battery & electric motor driving tractor propeller
Launch/recovery: hand or cat/auto

FANCOPTER

Length: 0.6m
Span: 0.6m (dia)
Maximum take-off weight: 1.5kg
Range: 1,000m
Endurance: 25min (3hr with perching)
Speed: NA
Altitude: NA
Payload:
Day: 2 x PAL resolution colour video CCD cameras, with wide angle and telephoto respectively. Downward looking video camera. Options: High-res stills or video camera. Night: Thermal IR and near-IR with illumination video cameras.
Powerplant: battery & electric motors driving protected counterrotating rotors
Launch/recovery: VTOL

FLIR SYSTEMS (PROX DYNAMICS)

BLACK HORNET

Length: 0.168m
Span: 0.123m
Maximum take-off weight: < 33g
Range: 2km
Endurance: 25min
Speed: 12kts
Altitude: > rooftop
Payload:
Day: 2 x EO cameras, 1 video, 1 high-res snapshot. Night: fused thermal and EO.
Serves or has served with the US Army, USMC, British Army, Australian Army, Norwegian Armed Forces, Dutch Army, German Army.
Powerplant: battery & electric motor drivng two-blade main and tail rotors
Launch/recovery: VTOL

GENERAL ATOMICS

PREDATOR B (MQ-9 REAPER)

Length: 11m
Span: 20m
Maximum take-off weight: 10,500lb
Range: LOS/global
Endurance: 27hr
Speed: 240kts
Altitude: 50,000ft
Payload: 386 kg internal, 1,361kg external
Sensors: MTS-B EO/IR turret, Lynx multi-mode radar, multi-mode maritime radar, AIS, SIGINT/ESM, comms relay
Weapons: Hellfire missiles, GBU-12, GBU-38, GBU-39 smart bombs
Operated by: USAF, US Homeland Security, Australia, France, Italy, Netherlands, Spain, UK (to be replaced by Protector), selected by India, Belgium.
Powerplant: Honeywell TPE331-10 turboprop driving pusher propeller
Launch/recovery: conv/conv

PREDATOR XP

Length: 8m
Span: 18m
Maximum take-off weight: 1,157kg
Range: LOS/global
Endurance: 35hr
Speed: 120kts
Altitude: 25,000ft
Payload: 147kg
EO/IR, Lynx multi-mode radar, comms relay
Powerplant: Heavily Modified Rotax 914 Turbo piston engine
Launch/recovery: conv/conv

GRAY EAGLE

Length: 9m
Span: 17m
Maximum take-off weight: 1,633kg
Range: LOS/global
Endurance: 25hr
Speed: 167kts
Altitude: 29,000ft
Payload: 261kg internal, 227kg external

EO/IR turret, SAR/GMTI radar, communications relay, 4 x Hellfire missiles. Operated by the US Army.
Powerplant: Thielert 165hp heavy-fuel engine
Launch/recovery: conv/conv

GRAY EAGLE EXTENDED RANGE

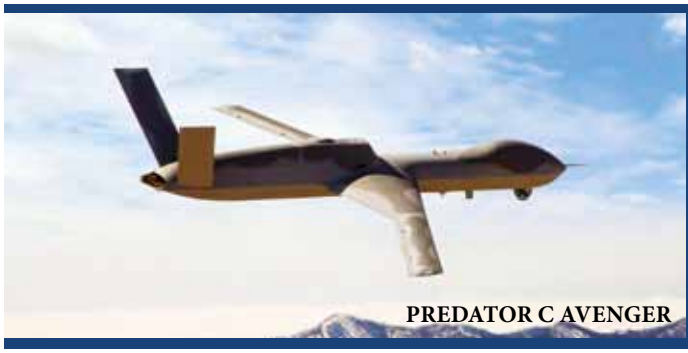
Length: 9m
Span: 17m
Maximum take-off weight: 1,905kg
Range: LOS/global
Endurance: 42hr
Speed: 167kts
Altitude: 29,000ft
Payload:

EO/IR, SAR/GMTI radar, communications relay. Open, modular architecture supports integration of three payloads simultaneously, with capacity for growth
Powerplant: 180hp turbodiesel engine driving pusher propeller
Launch/recovery: conv/conv

MQ-9B SKYGUARDIAN

Length: 11.7m
Span: 24m
Maximum take-off weight: 5,670kg
Range: LOS/global
Endurance: 40hr
Speed: 210kts
Altitude: > 40,000ft
Payload: 2,177kg

Raytheon MTS-B EO/IR, GA-ASI Lynx multi-mode radar, VHF/UHF certified radios
Powerplant: Honeywell TPE331-10 turboprop driving pusher propeller
Launch/recovery: conv/conv



PREDATOR C AVENGER

Length: 13m
Span: 20m
Maximum take-off weight: 8,255kg
Range: LOS/global
Endurance: 18hr
Speed: 350-400kts
Altitude: 50,000ft
Payload: 1,588kg

EO/IR, Lynx multi-mode radar, SIGINT/ESM, comms relay. Weapons: Hellfire missiles, GBU-12/49, GBU-31, GBU-32, GBU-38 JDAM, GBU-39, GBU-16/48 guided bombs
Powerplant: Pratt & Whitney PW545B turbofan engine
Launch/recovery: conv/conv

IAI

HERON

Length: 8.5m
Span: 16.6m
Maximum take-off weight: 1,270kg
Range: 350km LOS
Endurance: >45hr
Speed: 120kts
Altitude: 35,000ft
Payload: 470 g

Up to 6 sensors: EO/IR with LRF & designator, SAR/maritime patrol radar, COMINT, comms relay etc.
In addition to the IDF, has reportedly been tried, leased or bought by: Azerbaijan, Brazil, Canada, Equador, Germany, Greece, India, Morocco, Singapore, South Korea, Turkey and the US.
Powerplant: 1 x 115 hp Rotax 914 piston engine
Launch/recovery: conv/conv

HERON TP

Length: 14m
Span: 26m
Maximum take-off weight: 5,400kg
Range: LOS/global
Endurance: > 30hr
Speed: 220kts
Altitude: 45,000ft
Payload: 2,700kg
EO/IR/LRF/LD, synthetic aperture and maritime patrol radar, ELINT/COMINT & ESM.
Operated by the Israeli Air Force, reportedly selected by the Indian Air Force, leased by Germany.
Powerplant: 1,200 hp Pratt & Whitney Canada PT6 Turboprop driving pusher propeller
Launch/recovery: conv/conv

SEARCHER MK III

Length: 5.85m
Span: 8.55m
Maximum take-off weight: 450kg
Range: 350km
Endurance: 20hr
Speed: 110kts
Altitude: 23,000ft
Payload: 120kg
EO/IR or SAR/GMTI or SIGINT, aerial data relay
Operators include the Spanish Army
Powerplant: 4-str "silent" piston engine
Launch/recovery: conv/conv

BIRDEYE 400

Length: 0.8m
Span: 2.2m
Maximum take-off weight: 5.6kg
Range; 20 km
Endurance: 1hr 30min
Speed: 60kts max
Altitude: 1,500ft
Payload: 1.2kg
Colour TV/IR camera under belly for optimal coverage, stabilized picture with high-resolution imagery Export customers reportedly include Russia.
Powerplant: Battery & electric motor
Launch/recovery: hand or cat/flip-over & para

BIRDEYE 650

Length: NA
Span: 3m
Maximum take-off weight: 11kg
Range: 50km
Endurance: > 4hr
Speed: 70kts
Altitude: 1,500ft AGL
Payload: 1.2kg
Wide coverage, stabilised day/night payload and moving target tracker
Powerplant: battery & electric motor, pusher propeller
Launch/recovery: cat/flip-over & para

BIRDEYE 650D

Length: NA
Span: 4m
Maximum take-off weight: 30kg
Range: > 150km
Endurance: > 15hr
Speed: 80kts
Altitude: 15,000ft
Payload: 5.5kg
Wide coverage, stabilised day/night payload and moving target tracker
Powerplant: Gasoline fueled reciprocating engine
Launch/recovery: cat/para, flip over & airbag

PANTHER

Length: NA
Span: 8m
Maximum take-off weight: 71kg
Range: 130 km
Endurance: > 6hr
Speed: 50kt
Altitude: 3,000ft
Payload: 8.5kg
Mini POP EO/IR/laser pointer turret
Poweplant: Hybrid system with internal combustion cruise engine and tilting electric motors and props
Launch/recovery: VTOL

IDS

IA-3 COLIBRI

Length: 0.81m
Span: 0.81m
Maximum take-off weight: 5kg
Range: NA
Endurance: 40min
Speed: NA
Altitude: NA
Payload: 1.0kg
Stabilised reconnaissance sensors: IR thermal camera with a 320x240 resolution, 8-14 micron spectral band, EO zoom camera with 700 TVL resolution and 10x optical zoom.
Powerplant: 4 x 700W electric motors
Launch/recovery: VTOL

IA-17

Length: 1.27m
Span: 2.8m
Maximum take-off weight: 25kg
Range: 60 km LOS
Endurance: > 5hr
Speed: 160 kts
Altitude: 14,764ft
Payload: 2.5kg
Gyro-stabilized turret with 15x zoom CMOS day camera and 4x thermal imager for night operations
Powerplant: 2-str gasoline engine
Launch/recovery: cat/para

INDRA

PELICANO

Length: 3.4m
Span: 3.3m dia
Maximum take-off weight: 200kg
Range: 100km
Endurance: 4 to 6hr
Speed: 100 kts
Altitude: 11,811ft
Payload: 30 kg
Gyro-stabilized MMP EO/thermal camera, Automatic Identification System (AIS)
Powerplant: Heavy fuel engine burning JP5
Launch/recovery: VTOL

KOREA AEROSPACE INDUSTRIES - KAI

RQ-101

Length: 4.7m
Span: 6.4m
Maximum take-off weight: 300kg
Range: 80 km radius
Endurance: 6hr
Speed: 100kts
Altitude: 14,764ft
Payload: 85kg (inc fuel)
Dual sensor day TV & thermal imaging turret
Powerplant: Rotary internal combustion engine driving pusher propeller
Launch/recovery: cat/para or conv

L-3

APEX

Length: 1.85m
Span: 4.3m
Maximum take-off weight: NA
Range: > 100km
Endurance: > 6hr
Altitude: 18,000ft
Speed: 60kts
Payload: NA
EO, IR, EO/IR turrets from Controp's Stamp range, 3D imaging/ mapping
Powerplant: battery & electric motor driving pusher propeller
Launch/recovery: cat/para

LEONARDO

FALCO

Length: 5.25m
Span: 7.2m
Maximum take-off weight: 490kg
Range: > 200km
Endurance: 8 to 14hr
Speed: 117kts
Altitude: > 16,404ft
Payload: 70kg
EO/IR turret with laser designator, SAR/GMTI radar, multi-mode surveillance radar, AIS, ESM/COMINT, comms relay, hyperspectral imager.
Delivered to Pakistan Air Force
Powerplant: 65hp gasoline engine
Launch/recovery: conv/conv

FALCO EVO

Length: 6.2m
Span: 12.5m
Maximum take-off weight: 650kg
Range: > 200km
Endurance: > 20hr
Speed: NA
Altitude: 19,685ft
Payload: > 100kg
EO/IR with laser designator, laser marker, SAR/GMTI radar, multi-mode surveillance radar, AIS, ESM, COMINT, comms relay, hyperspectral sensor
Delivery to the first of two Middle-East/Gulf customers, thought to be Jordan and Saudi Arabia, in January 2018.
Powerplant: 80hp gasoline engine
Launch/recovery: conv/conv

HELISTARK

Length; 1.7m
Span: 1.8m
Maximum take-off weight: 20kg
Range
Endurance: 4hr
Speed: 54kts
Altitude: NA
Payload: 6kg
Powerplant: 5 hp 2-str engine
Launch/recovery: VTOL

HORUS

Length: 0.98m
Span: 1.65m
Maximum take-off weight: 2kg
Range: 5 to 10km
Endurance: 1hr
Speed: 58kts
Altitude: NA
Payload: NA
Optical sensor
Powerplant: battery, brushless electric motor drivng propeller
Launch/recovery: hand, 120mm mortar, cat

IBIS

Length: 1.7m
Span: 1.56m
Maximum take-off weight: 12kg
Range: 50 to 10km
Endurance: 35min
Speed: 49kts
Altitude: NA
Payload: NA
Optical sensor
Powerplant: LiPo battery, brushless motor driving main & tail rotors
Launch/recovery: VTOL

LOCKHEED MARTIN

DESERT HAWK III

Length: 0.9m
Span; 1.5m
Maximum take-off weight: 3.72kg
Range: NA
Endurance: 1.5hr
Speed: 50kts
Altitude: 11,000ft
Payload: 0.9kg
360-degree colour EO and IR video camera systems, plus other interchangeable, snap-on "Plug and Playloads"
Powerplant: battery & elecric motor driving tractor propeller
Launch/recovery: hand/conv skid

VECTOR HAWK

Length: 0.9m
Span: 1.5m
Maximum take-off weight: 2.72kg
Range: NA
Endurance: 2.5hr
Speed: 25-70kts
Altitude: NA
Payload: 0.9kg
High quality EO/IR sensors
Powerplant: smart battery & elecric motor driving tractor propeller, 100 percent waterproof
Launch/recovery: hand or canister/water or ground deep stall landing

CONDOR

Length: 1.75m
Span: 3.17m
Maximum take-off weight: 8.2kg
Range: 10 to 60km
Endurance: 2 to 10hr
Speed: 35kts
Altitude: NA
Payload: 2.72kg
3 in, 6 in, 9 in & 12 in payload bay modules fitted, depending on power source
Powerplant: Configurable electric power source with solar option
Launch/recovery: unassisted hand/spot

INDAGO

Length: 0.81m
Span: 0.81m
Maximum take-off weight: 2.3kg
Range: 2 to 10km
Endurance: 50min
Speed: 40kts
Altitude: 500ft AGL
Payload: 0.2kg
Multiple hot-swappable payload options for ISR, search & rescue etc
Powerplant: battery & 4 x electric motors driving vertical propellers
Launch/recovery: VTOL

KMAX

Length: 15.83m
Span: 14.71m dia
Maximum take-off weight: 3,175kg
Range: 1,852km est
Endurance: > 12hr
Speed: 100kts
Altitude: > 20,000ft
Payload: 3,109kg
Can carry up to 2,722kg externally on cargo hook
Powerplant: Honeywell T53-17 turboshaft driving intermeshing rotors, no tail rotor
Launch/recovery: VTOL

STALKER XE

Length: NA
Span: 3.66m
Maximum take-off weight: 10.9kg
Range: 93km
Endurance: 8hr
Speed: 45kts
Altitude: 12,000ft
Payload: 2.5kg
EO/IR with cursor-on-target, integrated tracker with scene lock moving target tracking, auto-track and follow navigation
Powerplant: solid oxide propane fuel cell & electric motor driving tractor propeller
Launch/recovery: cat/conv glide, VTOL option

LUCH

SOKIL 2

Length: 1.39m (tube)
Span: NA
Maximum take-off weight: 5kg
Range: 20km
Endurance: 2hr
Speed: 65kts
Altitude
Payload: 1kg
Video camera and radio link to send target imagery back to armoured vehicle
Powerplant: battery & electric motor driving pusher propeller
Launch/recovery: tube/NA

NORTHROP GRUMMAN

MQ-8B FIRE SCOUT

Length: 7.3m
Span: 8.4m dia
Maximum take-off weight: 1,429kg
Range: 1,104km
Endurance: 7.75hr
Speed: 85kts
Altitude: 12,500ft
Payload: 136kg
EO/IR/LRF, mine detector, comms relay, maritime radar, AIS
Powerplant: 1 x Rolls-Royce 250 turboshaft engine driving main and tail rotors
Launch/recovery: VTOL

MQ-8C FIRE SCOUT

Length: 12.6m
Span: 10.7m dia
Maximum take-off weight: 2,722kg
Range: 2,272km
Endurance: 12hr
Speed: 135kts
Altitude: 16,000ft
Payload: 300 to 500lb
EO/IR/LRF, comm relay, AIS, maritime radar (future), COBRA mine detector (future). Multiple payloads and configuration available
Powerplant: Rolls-Royce 250-C47E turboshaft engine driving main and tail rotors
Launch/recovery: VTOL

GLOBAL HAWK

Length: 14.5m
Span: 39.9m
Maximum take-off weight: 14,628kg
Range: 22,780km (ferry)
Endurance: 24hr @ 2,222km
Speed: 310kts loiter
Altitude: 60,000ft
Payload: 1,360kg
All-weather synthetic aperture, radar/moving target indicato, high-resolution electro-optical (EO) digital camera, and a third-generation infrared (IR) sensor working through common signal processor
Powerplant: Rollls-Royce AE3007 turbofan generating up to 8,500lb thrust
Launch/recovery: conv/conv

TRITON

Length: 14.5m
Span: 39.9m
Maximum take-off weight: 14,628kg
Range: 15,186km (ferry)
Endurance: > 24hr
Speed: 331kts
Altitude: 56,500ft
Payload: 1,452kg
The above figure is for internal payload. Triton can carry 1,089 kg externally.
Sensors: Multi-Function Active Sensor Active Electronically Steered Array (MFAS AESA) radar, MTS-B multi-spectral targeting system
Powerplant: Rollls-Royce AE3007 turbofan generating up to 8,500lb thrust
Launch/recovery: conv/conv

NORINCO

SKY SAKER CH4

Length: 8.5m
Span: 18m
Maximum take-off weight: 1,350kg
Range: 1640km
Endurance: 14/30hr
Speed: NA
Altitude: 22,500ft
Payload: 345kg
Powerplant: turbprop driving pusher propeller
Launch/recovery: conv/conv

NOSTROMO DEFENSA

YARARA

Length: NA
Span: 4m
Maximum take-off weight: 22.5kg
Range: 50km
Endurance; 6hr
Speed: 79kts
Altitude: 9,843ft
Payload: 5kg
IAI MicroPOP EO/IR turret
Powerplant: 1 x 8 hp Cubewano Sonic 35 multi-fuel rotary engine driving 3-blade pusher propeller mounted above the wing. Principal operator is the Argentinian Air Force.
Launch/recovery: conv/conv

PIAGGIO AEROSPACE

HAMMERHEAD

Length: 14.4m
Span: 15.6m
Maximum take-off weight: 6,146kg
Range: 8,149km
Endurance: 16hr
Speed: 395kts
Altitude: 45,000ft
Payload: 227kg
Quoted payload weight allows 16hr endurance. SkyISTAR mission system with sensors including FLIR Systems StarSafire 380HD EO/IR turret, Leonardo Seaspray 7300 E Radar. The Italian defence ministry has reportedly requested purchase of 20 aircraft.
Powerplant: 2 × 850 shp Pratt & Whitney Canada PT6A-66B pusher turboprops
Launch/recovery: conv/conv

SAFRAN

SPERWER MK II

Length: 3.5m
Span: 4.2m
Maximum take-off weight:
Range: 200km
Endurance: > 6hr
Speed: 90kts
Altitude: 15,000ft
Payload: 50kg
Safran Euroflir 350 day/night gyrostabilised optronic sensor (EO/IR). Principal operator is the French Army.
Powerplant: 1 x 70 hp Rotax 582 2-str engine
Launch/recovery: cat/para

PATROLLER

Length: 8.5m
Span: 18m
Maximum take-off weight
Range: 200km LOS
Endurance: 20hr
Speed: 110kts
Altitude: 20,000ft
Payload: 250kg
Safran Euroflir 410 EO/IR turret plus COMINT, SIGINT, radar and other sensors.
The French Army is due to receive Patroller systems in 2019.
Powerplant: 1 x 115 hp Rotax 914F 4-cyl turbocharged liquid cooled engine
Launch/recovery: conv/conv

SCHIEBEL

CAMCOPTER S-100

Length: 3.11m
Span: 3.4m
Maximum take-off weight: 200kg
Range: 200km
Endurance: > 6 to > 10hr
Speed: 120kts
Altitude: 18,000ft
Payload: 50kg
EO/IR sensors standars, with Synthetic Aperture Radar (SAR), Light Detection and Ranging (LIDAR) scanners, integrated spotlights and loudspeakers as options.
Initial orders came from the UAE and three undisclosed nations, and Camcopter has been either ordered or tested by many more.
Powerplant: 50hp rotary engine
Launch/recovery: VTOL

SURVEY COPTER

ALIACA

Length: 1.85m
Span: 3m
Maximum take-off weight: 12kg
Range: 10 to 50km
Speed: 52kts
Endurance: 3hr
Altitude: 9,843ft
Payload: 1.1kg
T120 gyrostabilised EO/IR turret
Powerplant: battery & 1 electric motor driving a single tractor propeller
Launch/recovery: cat/belly

TRACKER 120

Length: 1.54m
Span: 3.3m
Maximum take-off weight: 8.7kg
Range: 25km
Speed: 48.6kts
Endurance: 1.5hr
Altitude: 8,202ft
Payload: 1.1kg
T120 gyrostabilised EO/IR turret
Powerplant: battery and 2 x electric motors driving twin tractor propellers
Launch/recovery: hand/belly landing

DFV 2000 ER

Length: 2.27m
Span: 3.3m
Maximum take-off weight: 22.5kg
Range: 50km
Speed: 65kts
Endurance: 7hr
Altitude: 32,300ft
Payload: 2kg
T120 gyrostabilised EO/IR turret
Powerplant: 1 x fuel-injected 2-str engine
Launch/recovery: cat/conv

TAI

ANKA

Length: 8m
Span: 17.3m
Maximum take-off weight
Range: 200km
Endurance: 24hr
Speed: 117kts
Altitude: 30,000ft
Payload: 200kg
EO/IR laser designator and rangefinder, plus SAR/ISAR/GMTI sensors
Powerplant: 1 x 155 hp Thielert Centurion heavy fuel engine
Launch/recovery: conv/conv

TEXTRON UNMANNED SYSTEMS

SHADOW 200

Length: 3.4m
Span: 6.2m
Maximum take-off weight: 212kg
Range: 125km LOS
Endurance: 9hr
Speed: 110kts
Altitude: 18,000ft
Payload: 43kg
EO/IR, communications relay, optional laser designation, etc. Operators include the US Army, US Marine Corps, the Australian Army, the Italian Army, the Romanian Air Force and the Swedish Army
Powerplant: UAV Engines model 741 rotary engine
Launch/recovery: cat/conv, arrested

AEROSONDE

Length: NA
Span: 3.6m
Maximum take-off weight: 36.4kg
Range: 140km
Endurance: > 14hr
Speed: NA
Altitude: 15,000ft
Payload: 9.1kg
Carries day/night full-motion video, communications relay, signals intelligence and a customer selected payload simultaneously
Powerplant: Lycomin EL-005 two-stroke Otto cycle spark ignited engine
Launch/recovery: cat/net

THALES

TACTICAL (WATCHKEEPER)

Length: approx 5.7m
Span: 10.5m
Maximum take-off weight: 550kg
Range: 200km
Endurance: 16hr
Speed: 95kts
Altitude: 16,000ft
Payload: 150kg
Elbit Compass turret with visual, Infra-Red (IR) laser rangefinder and designator, Thales I-Master SAR/GMTI radar, radio relay, COMINT. Principal operator is the British Army.
Powerplant: Powerplant: 1 x 52 hp UAV Engines R802/902 rotary
Launch/recovery: conv/conv

SPY'RANGER

Length: NA
Span: 3.9m
Maximum take-off weight: 14kg
Range: 30km
Endurance: 3hr
Speed: 49kts
Altitude: 14,764ft (t/o)
Payload: 1.2kg
Powerplant: battery & DC brushless electric motor
Launch/recovery: cat/belly

FULMAR X

Length: 1.2m
Span: 3m
Maximum take-off weight: 20kg
Range: 800km
Endurance: 12h
Speed: 54kts
Altitude: 9,843ft
Payload: 8kg
EO/IR camera turret with fusion capability
Powerplant: 1 x gasoline & heavy fuel engine
Launch/recovery: cat/net

UMS SKELDAR

R-350

Length: 3.2m
Span: 3.5m (dia)
Maximum take-off weight: 150kg
Range: 80km
Endurance: >2hr
Speed:65kts
Altitude: 6,500ft
Payload: 42kg
Nose & fuselage payload bays support options including EO/IR cameras, LiDAR, multi- and hyperspectral imaging systems chemical sniffers
Powerplant: Turboshaft burning Jet A1, JP8 and powering main and tail rotors
Launch/recovery: VTOL, emergency para

V-200 SKELDAR

Length: 4 m
Span: 4,6 m (dia)
Maximum take-off weight: 235 kg
Range: 200km
Endurance: > 5hr
Speed: 81kts
Altitude: 9,842ft
Payload: 40kg
Options include: advanced EO/IR turrets, Sentient Vision ViDAR, SAR/GMTI radar, hyper-spectral and multi-spectral cameras, comms relay systems
Powerplant: 1 x 60hp Hirth 3503 fuel-injected heavy fuel engine burning Jet A1, JP5 & JP8
Launch/recovery: VTOL

YUGOIMPORT

STRSLJEN

Length: 8.75m
Span: 7.63m
Maximum take-off weight: 750kg
Range: 150km
Endurance: 4hr
Speed: 97.2kts
Altitude: 13,123ft
Payload: 350kg inc fuel
EO/IR/laser targeting turret, 12 x small diameter guided missiles or unguided rockets
Powerplant: 1 x Phoenix 180 turboshaft engine
Launch/recovery: VTOL

ZALA AERO GROUP

421-16

Length: NA
Span: 1.68m
Maximum take-off weight: 16kg
Range: 70km
Endurance: 4 to 8hr
Speed: 70-108kt
Altitude: 9,843ft
Payload: NA
Stablised sensor turrets including: Z-16EIK18/60 thermal imager, Z-16EIK60 IR imager, Z-16IK35/VKL thermal imager + video, Z-16F2/Vk stills + video, Z-160/Vk "Alarm 1" video
Powerplant: 1 x 2-str engine (4hr endurance) or 1 x 4-str engine (8hr endurance)
Launch/recovery: cat/para

421-16E

Length: NA
Span: 2.815m
Maximum take-off weight: 10.5kg
Range: 70km
Endurance: > 4hr
Speed: 59kts
Payload: 1.5kg
Powerplant: Electric motor driving pusher propeller
Type 16E+ sensor turret inc 16MP camera
Launch/recovery: cat/para

421-16EM

Length: 0.9m
Span: 1.810m
Maximum take-off weight: 6.5kg
Range: 50km
Endurance: 2.5hr
Speed: 59kts
Payload: 1kg
Type 16E+ sensor turret inc 16MP camera
Powerplant: Electric motor driving pusher propeller
Launch/recovery: cat/para

421-21

Length: 0.520m
Span: 0.6m
Maximum take-off weight: 1.5kg
Range: 2km
Endurance: 40min
Speed: 22kts
Payload: 0.3kg
Powerplant: 10,000 mAh 3S battery driving six vertical propellers (hexacopter)
Launch/recovery: VTOL

421-22

Length: 1.065m
Span: 1.065m
Maximum take-off weight: 8kg
Range: 5km
Endurance: 35min
Speed: 16kts
Payload: 2kg
Type 16E+ camera turret
Powerplant: 2 x 10,000mAh 7S batteries driving eight electric motors and vertical propellers (octocopter)
Launch/recovery: VTOL

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EMBRACING THE CONCEPT

The Australian Army is combining operational lessons learned with the creativity of its talented young soldiers to reshape its employment of UAVs.

Peter Donaldson

Lieutenant Colonel Keirin Joyce leads programme management for the Australian Army's UAV development, having transferred in 2005 from Army aviation to the then new UAV regiment as its first engineering officer.

"UAVs are a game changing technology with real potential to rapidly enhance mission outcomes for Army and to save soldiers lives", he told *Armada International*.

The Army had been experimenting with UAVs since 1995, but Australia's entry into the Iraq war spurred the purchase of Skylarks from Elbit in 2005 and the leasing of Insitu ScanEagles in 2006 and, subsequently, the purchase of the AAI Shadow 200. Flying over 45,000 hours with ScanEagle systems in Iraq and Afghanistan and another 10,000 hours on the Shadow has made the Army Australia's most experienced operator with, arguably, one of the most closely integrated and mutually complementary fleets anywhere.

MISSION TAILORED

At the small end of today's inventory is the FLIR Systems Black Hornet, a nano-helicopter small enough to fit in the palm of a soldier's hand that is deployed at platoon level. With 160 systems, the Australian Army is the biggest user of nano-UAVs anywhere in the world.

"The Black Hornet is spread across our special operations and all three of our combat brigades", he said. "That has all been rolled out this year, so it is in every combat platoon."

Combat teams at the company level are served by the AeroVironment Wasp AE hand launched fixed-wing micro-UAV, with a total of 65 systems deployed in every special operations and brigade combat team, so that every company has access to Wasp.

Above that, serving commanders at brigade level are two Shadow 200 tactical systems with four vehicles and two ground control stations apiece, all operated by the 20th Surveillance and Target Acquisition Regiment.

"We think that is a complementary and layered approach", he said. "Combat platoons care about the 2km bubble that those 30 soldiers are in, and that is what a Black Hornet system is capable of covering; it is a 2km, 25-minute system. Wasp for the company combat team is a 5km system that can stay airborne for 45 minutes. Then the Shadow 200s cover the brigade area of operations; it is a 100km system that flies for nine hours, and the brigade area of operations is approximately 150 x 150km", he said.

"With those we think we've got a pretty good mix because they complement the command teams that need the information, and their range and endurance are fairly tightly matched to the concepts of operations for those call signs."

HIGH LEVEL LESSONS

He emphasised that intelligence gathering and targeting capabilities proved the main enhancement to mission performance contributed by tactical UAVs, while as they fielded smaller systems they found that these were removing soldiers from danger.

"At the small system end, we don't need to send a pair or an individual soldier down into an intersection, around the corner in an urban environment or into a building without looking through a window first, over a hill or down a creek line any more. We just can send a small UAS to go and do that first."

Operational experience in the Middle East alongside United Kingdom, United States and Netherlands forces, he said, taught

them a number of lessons, the first being the importance of ownership. "If you want to adapt the way that you employ them, if you want to adapt the sensor technology on board, you have to own them. Nobody is going to lend them to you; they are already a scarce asset." Secondly, he added, like any other specialist capability, you have to embrace and champion it within the armed forces. "It has to be well trained, operated and supported to be at the peak of operational effectiveness."

The third lesson he highlighted concerns investing in soldier operators. "We've got to give them an operating environment and a framework to experiment, because that is where the real value is."

Without going into tactical minutiae, he added that the young soldiers are already having a major impact with their creativity. "They are completely de-constructing what we know about standard infantry and cavalry tactics; when we are fighting against ourselves in an exercise, we are really adapting and innovating our traditional tactics and procedures by employing the robotic UAVs."

The information UAVs gather also helps commanders plan and carry out their next steps with more confidence, he said. "We know that mission execution is now faster, it's more precise, and it's more effective because we know more about the battlefield."

One unexpected benefit is the way it has enabled the Army to engage with young people through a unique combination of STEM (Science, Technology, Engineering and Maths) subjects and competitive sport in the form of drone racing.

EXPERIMENTATION AND RENEWAL

Returning to the theme of experimentation, he said that the Army has also bought more than 300 DJI Phantom 4 consumer drones to be issued to every unit in the service, including reserves and the cadets, to try out for 18 months. "We were very proactive in ensuring that we issued drones to cadets as they really get this piece of technology and I am absolutely sure that our cadets will come up with a lot of really good ideas."

As the technology moves so fast, there is already a plan to replace the Black Hornet in the early 2020s as part of the soldier combat ensemble programme, while the Wasp is to be replaced in the mid-20s under Project Land 129 Phase 4 Bravo, for which the Army wants Australian industry to co-invest in a competitor. "We really want to support, enable and work closely with Australian industry where we can. There are a number of exciting Australian start-ups and experienced operators of drones in this country, we are developing the smarts in this space and to also support pathways into industry like our engagement with universities that have UAV programs"

A programme to replace the Shadow early in the next decade has also been approved, he said, one that will double the rate of effort and provide a third capability set, meaning three systems instead of two. This is also to address the requirement to support amphibious operations, he added.

Joyce noted that the Navy is experimenting with ScanEagle from its small vessels and the Schiebel Camcopter S100 from the larger ones and is planning to bring a capability into service in the '20s, and that the Air Force has both an armed Medium Altitude, Long Endurance (MALE) project equivalent to the UK Protector and has partnered with the US Navy on the Triton version of the Global Hawk.

"By the mid 20s we are going to have a unmanned aerial system from the platoon all the way up to the strategic level doing maritime patrol", he concluded.

"The future has arrived. Drones represent a defining opportunity for a country that is the size of Australia with the size of its defence force."

Lockheed Martin

ARES, or Aerial Reconfigurable Embedded System (ARES) is an unmanned VTOL flight module system designed to transport a variety of payloads.

FUTURE DIRECTIONS - YOU AIN'T SEEN NOTHING YET

The directions that UAVs may be developed in over the next couple of decades could be truly awesome.

Peter Donaldson

There is an old saying that technology drives tactics, and it encapsulates a truth that new technologies invariably end up being used in ways that their inventors and designers never intended. This certainly applies to UAVs. Many military personnel, given the chance to really get to know them, find better ways of employing them to keep themselves and their comrades safer and more informed. The number of occasions where soldiers have to go into situations "blind", is being drastically reduced.

One bold way of finding new missions for UAV technologies is to give them to military personnel and ask them to come up with ideas and to test them out in experiments. This is what the Australian Army plans to do with hundreds of off-the-shelf commercial drones, as Lt Col Keirin Joyce explained early in this *Compendium*.

UNPLANNED MISSIONS

Sometimes, however, new applications for UAVs emerge from recognition of capability gaps that must be filled so urgently that the direction of a major development programme has to change fundamentally. Such was the origin of the US Navy's MQ-25 Stingray, a carrier-based and somewhat stealthy aerial refuelling tanker that was originally conceived as an Intelligence, Surveillance and Reconnaissance (ISR) and/or strike platform under the Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) programme. The Lockheed Martin F-35 Lightning II Joint Strike Fighter lacks the unrefueled range to allow aircraft carriers to remain outside the engagement envelopes of weapon systems such as advanced anti-ship missiles increasingly deployed by near-peer potential adversaries, such as China and Russia. The MQ-25 could replace existing refuelling aircraft that were not stealthy enough to operate close to hostile advanced air defences, enabling the F-35's range to be extended to enable deep strike missions.

In February 2016, therefore, the US Navy announced its decision to repurpose much of the UCLASS effort into the Carrier Based Aerial Refuelling System (CBARS), a Hornet-sized tanker with some ISR capability but

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GA-ASI

Artist impression of what a GA-ASI Sea Avenger-based MQ-25 might look like.

others envisaged for UCLASS including strike and communications relay put off to a possible future variant. This programme gained the name MQ-25 Stingray in July of 2016.

Another mission that's new to UAVs, although not to manned aircraft, and that has emerged from a capability gap is Airborne Early Warning (AEW) for any US Marine Air Ground Task Force (MAGTF) that does not have the support of a Carrier Strike Group and its E-2D Hawkeyes. Future operations might require MAGTFs to operate in high-threat environments without carrier support in concepts such as distributed maritime operations, littoral operations in a contested environment and expeditionary advance base operations.

AIRBORNE EARLY WARNING

AEW, therefore, has emerged as the top priority Tier 1 mission for the MAGTF UAS Expeditionary (MUX) programme. Other Tier 1 missions include ISR, EW and communications relay, with offensive air support regarded as a Tier 2 role that it might be able to carry out unarmed by providing targeting cues for weapons launched by other platforms in the Cooperative Engagement Capability (CEC) network. Escort and cargo transport have been removed from the list of missions for this conceptual new VTOL/STOVL UAV.

VTOL/STOVL capability is essential for operation from amphibious ships, while a cruise speed requirement of 175-200kts would be within the capabilities of a helicopter, the requirement for eight hours on station 350nm from the ship might drive the solution towards a tiltrotor, ducted fan/tilt-wing or tail-sitter configuration that allows wing-borne cruising flight.

While a large, powerful radar is the type of sensor most closely associated with the AEW mission, US Marine Corps capability development director Brigadier General James Adams referred to a variety of sensors, transmitters and communications relays as payloads in a June MUX industry day. These would be networked back to the shipboard operations centre as well as integrating through Manned-Unmanned Teaming (MUM-T) capabilities with air, surface and ground based as-sault force assets. Basing its mission system on an open systems architecture would enable the 'latest and greatest' technology to be inserted shortly before the vehicle is expected to achieve its Initial Operational Capability (IOC) in 2032.

A ballpark figure for unit cost is reportedly somewhere between $25 million and $30 million.

VTOL with high speed forward flight is also the theme of an innovative and and protean DARPA concept that originated as Transformer X in 2009 and is now is being developed by Lockheed Martin and Piasecki Aircraft into a full-scale demonstrator of a system capable of resupplying small, isolated combat units, among other missions, including the MUX mission for which it is a potential candidate.

TILTING WINGS, DUCTED FANS

At the heart of the Aerial Reconfigurable Embedded System (ARES) is a tilt-wing twin ducted fan UAV capable of carrying a wide variety of payloads from ISR equipment to cargo to wounded soldiers, and boasting sufficient autonomy to safely choose its own landing sites without input from a human operator.

DARPA calls ARES a VTOL flight module with its own power system, fuel, digital flight controls and remote command and control interfaces. The operational concept calls for the flight module to travel between its home base and field operations to deliver and retrieve several types of mission-specific payload module.

Piasecki provided some more detail of on these in a presentation to the American Vertical Lift Society's (ex-American Helicopter Society) Transformative Vertical Flight Workshop in January. The company illustrated a tactical transport module that looked like some kind of four-seat light strike vehicle of the type used by special forces. Also shown were a wheeled cargo pod and a casualty evacuation pod that looks like a variant of the former. The third module shown was for insertion and extraction of special forces teams and resembles the front of an attack helicopter fuselage on skids and appeared to feature both an EO/IR pod and a gun turret. The final module was a longer fuselage-like structure with a vertical tail with what appeared to be a radar pod on top, a nose mounted EO/IR pod seemingly larger than the one on the SOF module and was fitted with three-point landing gear with two front and one tail wheel, this was intended for ISR and fire support missions.

With a useful load of more than 3,000lb, the air vehicle can carry 4x4 military vehicles and also be transported by them on roads and even off-road terrain. DARPA notes that the useful load accounts for more than 40 percent of the take-off gross weight, which gives a ballpark upper limit for that parameter of 7,500lb.

With the rotating fan blades protected by ducts it would be able to operate from spots about half the area of those needed by a small helicopter such as a Boeing AH6 Little Bird. While initially it would operate like a typical unmanned vehicle, the envisaged growth path includes semi-autonomous flight systems and user interfaces that will enable optionally manned flight.

ALTERNATIVE TRANSITIONS

Adaptability is a key theme in futuristic UAV concepts, and it comes in many flavours. Working with students from Cranfield University, BAE Systems last September revealed its own conceptual Adaptable UAV that uses an innovative method of switching between rotary-and fixed-wing flight and a novel pole for launch and recovery.

Illustrating their deployment in a Suppression of Enemy Air Defences (SEAD) mission, the company created a short vignette in which a UCAV operator detects a surface-to-air missile site and commands the vehicle to release a canister that descends on a parachute, opens like a clamshell and launches six or so UAVs that take the form of a doughnut-like ring with broad chord wings with a slight taper and a propeller on each leading edge. They slide down a pole in the centre of the canister that passes through the centre of the doughnut and fly off in fixed-wing mode to find and engage their targets, which are remotely

operated enemy missile launchers that they temporarily disable with what appears to be a sensor-obscuring foam spray, distributing the targets among them.

That done, they recover to another pole mounted on the turret of a main battle tank located an un-specified distance away. Shortly before recovery they switch to rotary wing flight, which they accomplish by pivoting one of the propellers from the leading edge of the wing to the trailing edge and causing the whole UAV to spin on its vertical axis. They then slow to a hover above the pole and slide down it one after the other. The vignette also shows them recovering in the same way to a surfaced submarine as an alternative.

The transition between the two flight modes would require adaptive flight control software, while advanced autonomy would enable them to adapt to rapidly evolving situations on future battlefields, working in cooperative swarms to disable sophisticated air defences as well as operating in complex urban environments.

The launch and recover pole permits the Adaptable UAVs to operate to and from a wide range of host vehicles in dangerous environments potentially cluttered with personnel, vehicles or aircraft. BAE Systems says that the pole constrains lateral movement of the UAVs so that strong winds cannot dislodge them, so the risk of injury to nearby personnel. Gyro-stablilisation of the pole ensures that it remains upright even if the host vehicle is on a slop or a ship is subject to rolling mo-tions during launch or recovery.

BUILD ON DEMAND

On the face of it, another DARPA/USAF programme, the Flying Missile Rail (FMR) might seem to be a concept born to patch up a shortcoming in another system, but there's much more to it than that. The FMR is intended to be able to detach from a tactical aircraft, such as an F-16 or an F/A-18, and fly ahead to a position from which it can launch an AIM-120 Advanced Medium Range Air-to-Air Missile (AMRAAM). Its basic speed and endurance requirements are Mach 0.9 and 20 minutes, it must be able to orbit selected waypoints, and it is also expected to be able to launch a missile while still attached to the host aircraft.

While this might look like little more than a range extension scheme for the AMRAAM, the requirement to develop the capability to manufacture them on demand at rates of up to 500 per month shows that advanced manufacturing technology is at least important as the vehicle and its operating concept.

USAF Lt Col Jimmy 'Reverend' Jones, a programme manager in DARPA's Strategic Technologies Office, emphasised that the FMR ethos is to reverse the business-as-usual approach to development; rather than stating what they want in terms of capability asking how fast they can get it, the question becomes here's how fast I want it, how much can I get?

DARPA recommends teaming between aircraft designers and manufacturers, stressing that the term rapid manufacturing does not mandate any specific process. The end goal is for all materials for the FMR to be available at the manufacturing site, with all components and manufacturing equipment procured in advance, shipped to a single location and stored awaiting assembly.

One potential instantiation of the idea it called a factory in a can. Here, raw materials CNC mills, metal dies and presses, electronics, cabling, etc would be procured, shipped to, and stored in a series of modified shipping containers. To maintain the capability, a skeleton crew would be trained to test its end-to-end functionality by delivering small numbers of FMR UAVs to ranges every year.

FMR is structured as a three-phase programme, with the first focused on design and evaluation of candidate vehicles and manufacturing approaches from competing teams. In the second phase, two teams are to demonstrate their vehicle designs, including fit checks on the F-16 and F/A-18, and their manufacturing systems, plus key risk reduction portions of the process. In the third, the rapid manufacturing is to be demonstrated and the FMR vehicle is to be flight tested.

Crucially, the whole approach is to be applied to a new rapidly designed system other than FMR. If successful, this concept could make the future of UAV systems and operations, potentially unleashing the creativity of military personnel empowered to make their own tools tailored to the missions that confront them. A

ON THE COVER:
1. A British soldier using a Saab nano Black Hornet UAV in Afghanistan. (*MoD*)
2. The Insitu RQ-21A Blackjack. (*Navair*)
3. The AeroVironment Swtchblade loitering munition. (*AeroVironment*)
4. British forces use the Thales Watchkeeper WK450 for ISTAR missions. (*Thales*)

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