Contribution of VTOL UAS to Information Advantage in the Maritime Domain

Presented at AAUS Autonomy in the Maritime Domain Conference Pacific 2019, Sydney, Australia
Overview

• Information Advantage in the Future Operating Environment

• VTOL UAS Concepts of Operation and Employment

• AWHERO and SW-4 “Solo” VTOL UAS, Ground Control Station & Data-Links

• ISR Payload Integration into VTOL UAS

• Integration of VTOL UAS with ship Combat Management Systems and the wider maritime force

• Concluding Remarks
Information Advantage in the Future Operating Environment

- Future Operating Environment will be complex, unstable & uncertain
- Adversaries will threaten stability of rules based international order
- Anticipate state-on-state and non-state competition, contested access to and control of all domains
- Information / Disinformation will be pervasive - influencing adversaries, stakeholders and audiences will be more complex
- An adversaries understanding, capability and desire to act can be affected by integrating information based activities with outreach and, as required, manoeuvre and strike
- Rapid information collect, processing and dissemination provides significant advantage – on any platform, anywhere, and any time

Joint Concept Note 1/17
Future Force Concept
Published by the UKMoD; July 2017

Informed by Global Strategic Trends
5th Edition

Global Strategic Trends
6th Edition
Published by the UKMoD; November 2018
Implications for Maritime Helicopters / VTOL UAS

- Maritime helicopters and VTOL-UAS required to protect national interests from increasingly capable airborne, surface and sub-surface threats.

- When necessary, will exert influence in and from the maritime domain, in the air above and into the littoral, and to support land and air forces with cross-domain Intelligence, Surveillance and Reconnaissance (ISR), power projection and logistics support.

- High-end war fighting capabilities including Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR), Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASuW), Mine Countermeasures (MCM) as well as Amphibious Support and Re-Supply

- Plus, constabulary operations to counter piracy, smuggling, people trafficking, drug trafficking, and terrorism; and Search and Rescue (SAR), and Humanitarian Assistance / Disaster Relief (HA/DR)
VTOL UAS Concept of Operations and Concept of Employment

Royal Navy Rotary Wing UAS Concept Capability Development (CCD) Phase 1

- Informed UKMoD / Royal Navy of suitability of Tactical Maritime UAS for wide range of missions including Intelligence, ISTAR, MCM & Hydrography
- Operation with Helicopters, Unmanned Surface Vessels and Unmanned Underwater Vessels

Leonardo In-House Studies

- Generated additional CONOPS/COMEMP for ASW, Naval Gun Fire Support using Precision Guided Weapons, Boarding Party Overwatch, SAR, and HA/DR
VTOL UAS Concept of Operations and Concept of Employment

Operations

• At distance from land bases and aviation capable ships
• All weather, day and night, in contested battle / cyber space, and in increasing threat environments
• Interoperable with maritime, air and ground vehicles when “over the beach”
• Teaming with other manned and unmanned assets will be commonplace

Resulting needs

• Long range/endurance, secure navigation and communications, sensor stand-off capability
• Rapid, secure and resilient Command & Control, Payload Management and Data Exchange via secure Line of Sight (LOS) and Beyond Line of Sight (BLOS) communications and data-links
Rotary Wing Unmanned Air Systems – AWHERO

- Heavy Fuel Engine for maritime operations
- 3 bladed main rotor reduces noise and vibration
- Triple redundant FMS and redundant power systems
- Nose and Fuselage Payload Bays – up to 3 concurrent payloads

AWHERO is capable of performing the following:
- ISTAR using maritime radar with Synthetic Aperture Radar (SAR) and ISAR modes, AIS and the MX-10 Electro-Optic Device
- Passive ISTAR using the Leonardo SAGE ESM and MX-10 EOD
- Relay of data from distant sonobouys to ASW helicopters or direct to ASW capable surface combatant for processing and analysis
- Relay of C2 and payload data for BLOS control of Unmanned Surface Vessels and Unmanned Underwater Vehicles
Rotary Wing Unmanned Air Systems – SW-4 Solo

• 1.8 tonne Optionally Piloted Helicopter based on the EASA certified SW-4.

• Optionally piloted capability, with an on-board pilot
  - enables remote operation in uncontrolled airspace
  - also facilitates trials / demonstrations of latest unmanned systems / technologies, and
  - operations in close proximity to manned assets.

• SW-4 Solo has an integrated Flight Management System / Flight Control System with triplex architecture

• Nose and fuselage payloads include EO/IR, AESA Radar w/ AIS, ESM, IFF and LIDAR
Rotary Wing Unmanned Air Systems – Common GCS

- Command & Control and Payload Management of AWHERO and SW-4 Solo is provided by a Common Ground Control Station

- Operator “In the Loop”

- Secure C2 and payload (wideband) datalinks – LOS 100km range

- Flight / Mission Planning and Re-planning using DTED map / Way Point Navigation

- Auto-takeoff, Auto-land, Autorotation and Lost Link profiles
ISR Payload Integration – Maritime Radar

Gabbiano Ultra-Light Sea Search Modes

- Sea Surveillance (up to 160 NM)
- High Sea State surveillance (up to 40 NM)
- Small Moving Target Indicator (SMTI) (Optional)
- Air to Sea Inverse Synthetic Aperture Radar (ISAR)
- Air to Sea Track While Scan
- Sea Target Recognition (Optional)
- Beacon (SART and SST-181X)

Flat Plate Nose Antenna

- 180 degrees azimuth coverage;
- Fast scan rate capability (> 90 Deg/s)
- Selectable sector scan: ±15°, ± 30°, ± 60°, ± 90°
- Wide elevation coverage: from 30° up to 30° down
ISR Payload Integration – Electronic Support Measures

SAGE 600 ESM

- Band Coverage: 2GHz to 18 GHz
- 360 degrees azimuth coverage
- Elevation coverage: ±45 degrees
- Very high sensitivity and DF accuracy in ESM mode
- High accuracy single platform geo-location
- Fully programmable Mission Data File
- ESM/ELINT systems gather intelligence through passive “listening” to signals of interest
- Creates library of technical and operational data on systems of interest
ISR Payload Integration – Electro Optic Device

MX-8 Electro-Optic Device

- 4 sensor payloads simultaneously
  - Thermal, Colour-Daylight & Low-Light Imaging
  - Continuous Zoom IR & EO
  - Eyesafe Laser Rangefinder & Laser Illuminator
- Image Processing
  - Real time image enhancement
  - Feature recognition and identification
  - Automated Video Tracker
  - 2x, 4x, Ezoom

MX-10 Electro-Optic Device Enhancements

- 6 sensor payloads simultaneously
- Laser Designator
- High Definition IR / Pseudo Colour IR
- Advanced Video Tracker
- Embedded Moving Target Indicator
ISR Payload Integration – AIS

Saab R5A AIS

• Applications
  • Search & Rescue – Locate Vessel
  • Maritime Surveillance / Monitoring – Track AIS equipped vessels
  • Active Identification – In combination with radar, detect suspect vessels
  • Homing – Locate AIS equipped vessels to land on

• Functionality
  • Receive from AIS equipped units
  • Transmit to AIS equipped units
  • User control – autonomous transmit, manual transmit, receive only
ISR Payload Integration – IFF

Sagetech MX-12B Mode V Transponder

- Mode V IFF mandated by NATO to be operational by 2020

- Modern day “Challenge and Response” password system; when contacted, friends reply with correct code; those that don’t are potential hostiles

- Sagetech MX12B will support:
  - Civil Mode A, C, S, and ADS-B In/Out
  - Military Modes 1, 2, 3, and 5.
### ISR Payload Integration – Configuration Options / Endurance

**Active and Passive ISR Payload Options**
- Radar, EO/IR, AIS, IFF – 6hrs endurance
- EO/IR, AIS, IFF - >6 hrs endurance
- EO/IR, ESM, AIS, IFF – up to 6hrs endurance

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<th>Radar &amp; 8” EO/IR</th>
<th>10” EO/IR</th>
<th>8” EO/IR ESM 360°</th>
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VTOL UAS / Large Ship Integration

Unmanned Warrior ‘16

- SW-4 Solo with Opsrey ASEA radar with AIS, SAGE ESM and EOD exchanged data with representative CMS through UK MoD “OACS / MAPLE” system architecture
- Leonardo operative in Ops Room was in direct communications with GCS operatives to provide connectivity between “taskers” and “operators”

Shared Infrastructure Demo (BAES/Leonardo/RN), DSEI, London, 2019

- SI is Open Architecture System currently being fitted to RN warships
- DSEI demonstration was first integration of multi level secure off board systems
- Allows RN to develop CMS capabilities by deploying new 3rd party capabilities via a host environment and common services alongside, and without compromising, the existing ships CMS
- Provides opportunity to rapidly integrate VTOL-UAS C2 and Payload Management capabilities with RN ships
VTOL UAS Manned / Unmanned Teaming

- RWUAS will augment manned platforms in the short – mid term
- ISR Collect
  - Series Operations: AWHERO provides wide area surveillance for longer periods and at lower operating cost than manned helicopters
  - Parallel Operations: AWHERO monitors alternative area to manned helicopter or provides over watch of manned helicopter operations
- ASuW
  - AWHERO provides wide area persistent surveillance with manned helicopter on quick alert to provide rapid reaction / strike capability
- ASW
  - AWHERO can relay acoustic data from a sono-buoy field to suitably equipped ASW helicopter or directly to an ASW capable ship
- AMCM
  - AWHERO can relay C2 and Payload data to/from USVs and UUV operating Beyond Line of Sight from mother ship
VTOL UAS – Manned Unmanned Teaming – Data / Video Transfer

Exercise Italian Blade Air to Air Demo (2015)

- SW-4 Solo and AW-129D, UH-90 and CH-47C helicopters operated as Tactical Communications Nodes exchanging digital information to support Close Air Support (CAS) and Close Combat Attack (CCA) ops
- SW-4 Solo’s radar and EO/IR sensors provided target position, still pictures and FMV to manned helicopters using ROVER4
- SW-4 Solo Ground Control Station received data from manned helicopters for re-tasking / re-positioning of SW-4 Solo

Leonardo Air to Air / Air to Ground Demo (October 2018)

- Transfer of tactical data and FMV video between AW159 Wildcat Helicopter WAH-64D Attack Helicopter and Foxhound Protected Patrol Vehicle
  - AW159 Full Systems Integration Rig with VORTEXi and Data Modem (IDM)
  - WAH-64D Mission Avionic System Rig with ROVER6i and IDM fitted
  - Foxhound with Joint Common Remote Viewing Terminals and BOWMAN
VTOL UAS Manned Unmanned Teaming – Control of VTOL UAS

• Demonstrated Level of Interoperability 4 (control of flight) of a Rotary UAS by an AW159 in a synthetic environment as part of a UK MoD sponsored programme

• Flight path control, excluding take-off and landing, was enabled for the front seat aircrew of AW159

• Demonstrated that battlespace digitisation and teaming reduces the OODA* loop timescales to increase ISR capability

• Awarded UK MOD DASA contract to support the British Army Warfighting Experiment (AWE19) exercise in Q1 2020

• Demonstration of STANAG 4586 compliant Manned Unmanned Teaming up to Level of Interoperability (LOI) 4 of the 2 crew AW159 and a UAV

• The AW159 HMI will be developed with the UK MOD to optimise aircrew workload.

*Observe – Orient – Decide - Act
VTOL UAS Teaming – Multiple UXV / Multiple Ships / Networking

- OCEAN 2020 managed by Leonardo on behalf of EDA
- Demonstration of significant improvement of maritime Situation Awareness through integration of UXVs with ISTAR payloads
- Interoperability by use of open architecture / recognised standards

- High levels of integration among EU countries and heterogeneous systems operation during full-scale demonstrations in:
  - Mediterranean Sea in 2019 (SW-4 Solo / AWHERO / NH-90)
  - Baltic Sea in 2020
- Development of EU C4ISR open architecture and integration of EU/NATO/civil data framework
- Demonstration of advanced data and information fusion techniques for shorter decision time at CMS and MOC levels
- Increased autonomy for UXS, swarm operations and cooperation of assets
Concluding Remarks

• The Future Operating Environment will increase demands on the maritime force – especially ISR above, on and below the surface

• Leonardo’s manned maritime helicopters conduct full spectrum of maritime operations providing Leonardo with a unique perspective when developing VTOL UAS capabilities for the maritime

• Leonardo at forefront of maritime VTOL UAS platform and system development such as AWHERO with Radar and ESM integrated with EOD, AIS and IFF, plus payloads such as Comms Relay

• Demonstrations of manned unmanned teaming such as OCEAN 2020 are showing a significant increase in maritime capabilities

• Future maritime force will be a formidable mix of manned and unmanned platforms fully integrated with surface, sub-surface, air and ground assets

• Leonardo continues to develop new technologies and capabilities to ensure its VTOL UAS platforms and systems deliver maximum operational benefit to the integrated force
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Contact details

Tony Duthie
Head of Land & Maritime Marketing
Leonardo Helicopters
Yeovil, BA20 2YB
United Kingdom