Development of Tactical Unmanned Air Systems at Leonardo

Australian Association for Unmanned Systems
25th – 26th February 2019
Overview

• Leonardo and UAS

• Current and Future Trends

• Platform capabilities: Falco, SW-4 Solo, AWHERO

• Manned Unmanned Teaming

• Capability Demonstrations

• Next Generation VTOL-UAS

• Closing Remarks: Challenges and Opportunities
Leonardo and UAS

• Over 100 years fixed/rotary wing experience.
• UAS activities started in 1950s:
  • Meteor target drones (1956) then Mirach UAS (1970s)
  • Westland Wisp & Wideye rotary UAS (RUAS) in 1970s
  • Helicopter launched Mirach UAS in 1980s.
• Mirach 26 fixed wing UAS developed during 1990s for battlefield surveillance
• Falco UAS development in early 2000s
• Development of advanced helicopter / system technologies in 2000s
  • Digital AFCS, integrated FMS, 4D NAV, Comms and Datalinks; all appropriate to RUAS
• Development of SW-4 Solo Optionally Piloted Helicopter and AWHERO Rotary UAS in 2010’s
CURRENT AND FUTURE TRENDS

WIDE USER COMMUNITY / MULTIPLE ROLES & MISSIONS:
• Community includes Commercial Users, Regional / National Governments and Agencies, NGOs, International Agencies and National Militaries and Alliances
• Missions include ISR and Logistics to Intervention /Strike

TRENDS:
• Commercial users want UAS to reduce costs and risks of commercial activities
• Government / NGO/ International Agencies using fixed wing UAS to deliver BLOS ISR capabilities in remote / hostile regions; BLOS cargo in the future
• Emergency Services using small UAS for local ISR and supply of High Value / Time Critical supplies; larger UAS needed for BLOS ISR/Search & heavier cargo
• Militaries, led by USA, introducing mainly fixed wing HALE/MALE/Tactical systems delivering “Find, Fix and Strike” and rotary wing micro / small land systems delivering “Find” with exception of rotary wing MQ-8B/C Fire Scout providing ISTAR to USN and KMax providing resupply capabilities to USMC.
• Outside the USA there have been many studies, trials and operational demos of similar sized / smaller RUAS to inform defence/government acquisition decisions
• As battlefield threats increase, shift towards runway independent (VTOL) UAS

INTEGRATION:
• Tactical and larger UAS have to be integrated into Air/Land/Maritime Surface & Sub-Surface domains in Commercial / Government and Military environments
FIXED WING UAS HERITAGE

Meteor P1

1956

Mirach 100 Recce

1978

Mirach 100/2 Recce

CL-89

1982

Mirach 100/2

1978

Mirach 100/4

RAM CFG

1998

N.A.M.F.I. Tactical Firings

FAST RECCE

Mirach 100/5

1998

Mirach 100/X

2005

Locusta

Air Targets

Mirach 20

1986

Mirach 70

1973

Mirach 26

1997

Falco Maiden Flight

2003

Falco EVO

2012

1st Civil Aviation clearance for a UAS in Italy

1st Civil Aviation clearance for a UAS in Europe

Falco EVO – BLK62

ISTAR

Mirach 150

1998

Fast Recce (Nibbio/Carapas)

2005

1986

1986

1978

1978

1988

1996

2005

2008

2012

2005

2006

70+ YEARS

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FALCO XN and FALCO EVO

First Permit to Fly ENAC in 2005 (Sardinia)

Over 30.000 flight hours logged in three continents

MTOW
- FALCO XN: 490 Kg
- FALCO EVO: 650 Kg

Mission payload
- FALCO XN: 70 Kg
- FALCO EVO: > 120 Kg

Max. alt. (ASL)
- FALCO XN: > 18,000 ft
- FALCO EVO: > 24,000 ft

Max. Endurance
- FALCO XN: 14+ h
- FALCO EVO: 24+ h

Mission
- FALCO XN: ISR
- FALCO EVO: ISR

Border Patrol; Search & Rescue; Coastal / Homeland Security; Law Enforcement, Environmental Monitoring; Peace Keeping
FALCO EVO: PERFORMANCE & CAPABILITIES

PERFORMANCE:
- Max Endurance Basic E/O >24 hours*
- Datalink Range (LOS): >110 NM
- Datalink Range (BLOS): >500 NM
- Max transfer speed: 120 Kts
- Max operational altitude: 24,000 ft
- Take Off Distance: 1,500 ft
- Operating Temperatures: -21/+49 C
* > 22 with parachute installed

CAPABILITIES / FEATURES
- Routine night operations with seamless integration in civil/military airports
- Fully qualified ATOL
- Low visual, noise, RCS and IR signatures
- Turbocharged Heavy Fuel engine; multi-fuel
- BLOS ops using Datalinks / SATCOM
- Net-Centric enabling data dissemination
- Emergency Recovery System with Parachute

MANNING
- Pilot, Payload Operator, GCS Operator
- Avionic Engineer, Mechanical Engineer
FALCO EVO GROUND SEGMENT C2/C3

Ground Data Terminal (GDT)
Autonomous and self-deploying (12 m), hosting all RF equipment and antennas.

Data-Links
>200km C or S Band WBDL
>200km UHF NBDL
Back up NBDL
>500km with SATCOM

External C4I
Wide Area Network
STANAG 4609 format

Ground Control Station (GCS)
ISO 20ft Shelter
UAV Control & Preliminary Data Exploitation
Leonardo deploys Falco EVO for Frontex trials

Leonardo’s Falco EVO Remotely-Piloted Air System (RPAS), in a maritime patrol configuration, has been deployed from Lampedusa under the Frontex surveillance research programme.

Leonardo’s Falco EVO Remotely-Piloted Air System (RPAS), in a maritime patrol configuration, has been deployed from Lampedusa airport as part of the Frontex surveillance research programme to test its ability to monitor the European Union’s external borders.
SW-4 “SOLO” OPTIONALLY PILOTED HELICOPTER

PERFORMANCE
• 5 hrs endurance / 93kg payload at 1.8T MTOW

CORE SYSTEMS
• Remote Engine Start-up/Shutdown capability
• Auto Take-off / Landing capability
• Integrated FMS/FCS (Triplex architecture)
• Ground Control Station (GCS)
• Line Of Sight (LOS) data-links; Command & Control (C2) and Mission (back-up for C2)
• Lost Link management

MISSION SYSTEMS
• Mission Data Link - 70 nm range
• Leonardo PicoSAR or Opsrey AESA Radar
• Leonardo SAGE Electronic Support Measures (ESM)
• Leonardo VigilX (Visual Situational Awareness)
• EO/IR with Laser Designator
• On Board Pilot interface (TacView®)
SW-4 “SOLO” GROUND CONTROL STATION

• Mission Planning / Re-planning
  • Flight Planning based on DTED map
  • Auto-takeoff, Auto-land, Autorotation and Lost Link profiles
  • Flight plan using Way Point navigation
  • Mission database updated via datalink

• Pilot “in the loop” control
  • Activates each mission phase
  • Can abort take-off and landing

• Automatic safety features implemented in SW-4 “Solo” Flight Control System:
  • autorotation in case of engine failure
  • ground avoidance through safety height protection
  • torque protection
  • vortex ring protection
AWHERO ROTARY WING TACTICAL UAS

• 200kg class Tactical UAS for Land and Maritime ISTAR operations

• Heavy Fuel Engine, 3 blade main rotor

• Triple redundant Flight Management System

• Secure C2 and payload (wideband) datalinks

• Nose and Fuselage Modular Payload Bays - EO/IR, AESA Radar, ESM, IFF, LIDAR, AIS, Stores

• Common Ground Station for C2 and Payload Mgt

• Air & Land Transportable in 20ft ISO Container

• Maritime capable with deck-lock and blade fold
AWHERO ISTAR PAYLOADS

- AESA Radar
- Maritime Radar
- Sage ESM
- AIS
- Comms Relay
- EO/IR
- Hyperspectral Camera
- LIDAR

Endurance Performance: 6 hours @ 35Kg
EVOLUTION OF AWHERO: PROGRAMME STATUS

**FCS Upgrade**
- Fully Automatic Deck Landing
- Enhanced Mission Functionalities

**Onboard Systems**
- New Rotary HF Liquid Cooled Engine
- Composite Drive Shaft
- Optimized Fuel System
- New Electrical Power Generation System

**Airframe**
- Optimized Fuselage Aerodynamics
- Optimized Blade Design
- New Landing Gear
- Titanium Mast
- New Horizontal & Vertical Tail

**Programme Launch**
2012

Pre-Production Vehicle
1st Flight December 2018
Military Type Certificate
Q4 2019

New dev’t & production facility opened in Feb 2019
MANNED / UNMANNED TEAMING

Land
- Medium endurance RUAS augment manned or optionally piloted battlefield helicopters
- Optimise ISTAR operations by operating RUAS instead of, or concurrently with, manned platforms
- “Find & Fix” targets / threats ahead of airborne force for subsequent avoidance or engagement

Maritime
- Small 200kg class RUAS hangared with manned helicopter or in modular mission bay
- Operating with single embarked manned helicopter, RUAS provides additional persistent ISR capability when manned helicopter is on ship (refuelling, crew rest etc.) or
- Provides second set of “eyes on target” / overwatch concurrent with manned helicopter

<table>
<thead>
<tr>
<th>Manned Helo 3hrs Endurance</th>
<th>Tactical RUAS 6hrs Endurance</th>
<th>Manned Helo &amp; RUAS 100%</th>
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<td>24 hours</td>
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DEMONTRACTIONS: MANNED UNMANNED TEAMING

Italian Blade (2015) – Air to Air

• SW-4 Solo and AW-129D, UH-90 and CH-47C helicopters operated as Tactical Comms 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 helos using ROVER4

• SW-4 Solo Ground Control Station received data from manned helicopters for re-tasking / re-positioning of SW-4 Solo

Leonardo (2018) – Air to Air / Air to Ground

• Transfer of tactical data and FMV video between surrogate RUAS (Reconnaissance Helicopter), Attack Helicopter and Ground Vehicles

• Demonstrated potential of increased interoperability between air and ground assets to UK armed forces
DEMONSTRATIONS: ROYAL NAVY RUAS CCD

• Informed UKMoD / Royal Navy of suitability of Tactical Maritime UAS (TMUAS):
  • wide range of maritime missions including ISTAR, MCM & Hydrography
  • operation with manned helicopters, Unmanned Surface Vessels (USV) and Unmanned Underwater Vessels (UUV)

• CCD Phase 1 delivered:
  • Cost & Operational Effectiveness Analysis
  • High Level System Definition for TMUAS
  • RUAS Technology Roadmaps
  • Demonstration of RUAS launch and recovery using SW-4 “Solo”
  • Demonstration of RWUAS payload data feed into ship Combat Management System

• CCD Phase 2 nearing completion
  • Refinement of design concepts for next generation VTOL-UAS
DEMONSTRATIONS: UNMANNED WARRIOR ‘16

- World’s first large scale demonstration of marine robotic systems hosted by the UK
- Over 50 aerial, surface and underwater Maritime Autonomous Systems (MAS) demonstrated surveillance, intelligence-gathering and mine countermeasures capabilities.
- SW-4 Solo equipped with Leonardo Opsrey ASEA radar with AIS, Leonardo SAGE ESM and EOD
- SW-4 Solo exchanged data with representative Type 23 Frigate Ops Room / Combat Management System through UK MoD sponsored “OACS / MAPLE” system architecture
- Leonardo operative in Operations Room was in direct communications with GCS operatives to provide the required connectivity between the “taskers” and the “operators”
RN CCD PHASE 2: NEXT GENERATION VTOL UAS

PERFORMANCE – CARDINAL POINTS
• 1,000kg to 2,000kg MTOW (Trade Space)
• 600kg to 1,200 kg Payload & Fuel (Trade Space)
• Endurance 12 hours w/ 125kg equipment
• Secure BVLOS operations
• Hot & High operations over land
• Maritime operations in Sea State 6 and above

DUAL USE CAPABILITIES – MODULARITY
• Maritime Surface & Land ISR (Radar, EW, EOD)
• Underwater ISR (ADS, Acoustics Processing, Multi-Spectral Sensors)
• UUV / UGV Delivery and Recovery; UAS Launch
• Cargo Delivery – Maritime and Land
• Weapons (Land Strike, ASuW, ASW, MCM)
• Transportable in ISO 20ft containers

COSTS / MANNING - TARGETS
• 50% of acquisition and through life costs of 6,000kg maritime helicopter
• Minimise manpower – lean manning / multiple-platform capable
DEMONSTRATIONS: OCEAN 2020

OPERATIONAL OBJECTIVES
• Significant improvement of maritime Situation Awareness through the integration of UXVs with ISTAR payload capabilities
• Interoperability by use of open architecture and recognised standards

TECHNICAL OBJECTIVES
• High integration among EU countries and heterogeneous systems: full-scale demos
  • Mediterranean Sea demo in 2019 (SW-4 Solo and AWHero participating)
  • Baltic Sea demonstration in 2020
• Development of EU C4ISR open architecture
• Integration of EU/NATO/civil data framework
• Advanced data and information fusion techniques for shorter decision time at CMS and MOC levels
• Increased autonomy for UXS, swarm operations, cooperation of assets
CLOSING REMARKS: CHALLENGES & OPPORTUNITIES

CHALLENGES – What is holding us back?
• Technology to enable safe and (cyber) secure BLOS operations, especially those at low level in uncontrolled, congested, and potentially contested airspace.
• Civilian and military regulatory authorities working together to harmonise their approach to integrating UAS into the national and international air traffic systems - do we integrate or segregate?
• Users need to determine how UAS will be operated:
  • at a local level with local control, or
  • integrated into the whole force realising the benefits of fully networked capabilities, manned unmanned teaming and cross domain integration, and
  • treated as a manned platform or as sensor / delivery mechanism / effector

OPPORTUNITIES – The future is bright, but we need to:
• Be ready, not just from a platform and systems perspective, but also
• Ensure operators and users can successfully integrate UAS into their wider force structure whether it be civilian, government or military
• Work with the regulators to deliver the airworthiness and operational safety case approvals (especially in the maritime) and
• Deliver first class training to ensure safe operations and
• Deliver cost-effective through life support to ensure system availability
Thankyou for your attention.
Questions?