Airworthiness Regulatory Framework for Military – Civil RPAS

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Scope

- Understand differences / specialties of unmanned aircraft comparing to manned in airworthiness domain
- Provide a brief overview of recent evolutions in AW domain concerning unmanned aircraft systems (UAS) (for both military and civil UAV)
Unmanned Aircraft Systems Definition

Drones?

UAVs?

OR

UAS?

RPAS?
Unmanned Aircraft Systems (UAS)

Autonomous Aircraft
- RPA conducting autonomous flight segments
  OR
- Autonomous aircraft conducting remotely piloted flight segments

Model Aircraft
- RPA used for recreational purposes
  OR
- Model aircraft used for other than recreational purposes

Remotely Piloted Aircraft
Unmanned Aircraft Systems (UAS) Categories

- Autonomous Aircraft Systems
- Remotely Piloted Aircraft Systems (RPAS)
  - Remotely Piloted Aircraft (RPA)
  - Command & Control (C2) Link
  - Remote Pilot Station (RPS)
    [Ground (Mission) Control Station]
Manned vs Unmanned Aircraft Certification Differences

Manned Aircraft
- Aircraft
- Engine
- Propeller
- Parts and Appliances

RPAS
- Aircraft
- Engine
- Propeller
- Parts and Appliances

C2 Link
- Remote Pilot Station

TC
- CofA
- EASA Form 1
- EASA Form 1
- EASA Form 1
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ETSO
Military RPAS Categorization

<table>
<thead>
<tr>
<th>WEIGHT (kg)</th>
<th>NATO</th>
<th>EDA</th>
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<tbody>
<tr>
<td>0 – 2</td>
<td>Micro</td>
<td>CAT I **</td>
</tr>
<tr>
<td>2 – 20</td>
<td>Mini</td>
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</tr>
<tr>
<td>20 – 150</td>
<td>Small</td>
<td>CAT II</td>
</tr>
<tr>
<td>150 – 600</td>
<td>Tactical</td>
<td></td>
</tr>
<tr>
<td>&gt; 600</td>
<td>Strategic</td>
<td>CAT III</td>
</tr>
</tbody>
</table>

- Categories reflect to UAS size/weight and mission
- Categories do not take into account other important parameters (such as UAV kinetic energy, data link and air traffic insertion requirements, etc)

* Categorization procedures not finalized
** Subcategories are included
## NATO UAS Classification Guide (Sep 2009)

<table>
<thead>
<tr>
<th>Class</th>
<th>Category</th>
<th>Normal employment</th>
<th>Normal Operating Altitude</th>
<th>Normal Mission Radius</th>
<th>Primary Supported Commander</th>
<th>Example platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS I (less than 150 kg)</td>
<td>SMALL &gt;20 kg</td>
<td>Tactical Unit (employs launch system)</td>
<td>Up to 5K ft AGL</td>
<td>50 km (LOS)</td>
<td>BN/Regt, BG</td>
<td>Luna, Hermes 90</td>
</tr>
<tr>
<td></td>
<td>MINI 2-20 kg</td>
<td>Tactical Sub-unit (manual launch)</td>
<td>Up to 3K ft AGL</td>
<td>25 km (LOS)</td>
<td>Coy/Sqn</td>
<td>Scan Eagle, Skylark, Raven, DH3, Aladin, Strix</td>
</tr>
<tr>
<td></td>
<td>MICRO &lt;2 kg</td>
<td>Tactical PI, Sect, Individual (single operator)</td>
<td>Up to 200 ft AGL</td>
<td>5 km (LOS)</td>
<td>PI, Sect</td>
<td>Black Widow</td>
</tr>
<tr>
<td>CLASS II (150 kg to 600 kg)</td>
<td>TACTICAL</td>
<td>Tactical Formation</td>
<td>Up to 10,000 ft AGL</td>
<td>200 km (LOS)</td>
<td>Bde Comd</td>
<td>Sperwer, Iview 250, Hermes 450, AeroStar, Ranger</td>
</tr>
<tr>
<td>CLASS III (more than 600 kg)</td>
<td>Strike/Combat</td>
<td>Strategic/National</td>
<td>Up to 65,000 ft</td>
<td>Unlimited (BLOS)</td>
<td>Theatre COM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HALE</td>
<td>Strategic/National</td>
<td>Up to 65,000 ft</td>
<td>Unlimited (BLOS)</td>
<td>Theatre COM</td>
<td>Global Hawk</td>
</tr>
<tr>
<td></td>
<td>MALE</td>
<td>Operational/Theatre</td>
<td>Up to 45,000 ft MSL</td>
<td>Unlimited (BLOS)</td>
<td>JTF COM</td>
<td>Predator B, Predator A, Heron, Heron TP, Hermes 900</td>
</tr>
</tbody>
</table>
NATO UAS Policy

- NATO UAS Policy (Approved by MS on Feb 2017)

- Policy Purpose:
  - Promote a coherent and consistent approach to UAS across the Alliance.
  - Guide the development and continuance of appropriate organizational structures and international and multinational cooperation with Members, Partners and international organizations.

- Policy deals with:
  - Operational employment (operational standards, exercises, counter UAS operations, etc.)
  - Capability development (UAS integration, C2 architecture, etc.)
  - Airspace Coordination (UAS airspace access, UAS AW, Crew qualifications)
  - RPAS Specific Considerations (not covers autonomous UAS)
Military UAS AW in EU

- EU Member States policy about RPAS
  - Harmonization of ATM and AW between civil – military stakeholders.
  - Common use of Single European Sky (SES) by civil / military RPAS
  - Dual Use (Civil/Military) RPAS manufactured by EU aerospace industry

- EDA tasked to develop a robust AW framework for RPAS, harmonized to civil relevant framework
EDA - Military RPAS Regulatory Framework

- Military RPAS Airworthiness Regulatory Framework (ARF) Working Group [under EDA Military AW Authorities (MAWA) Forum] is tasked to develop the relevant framework for military RPAS

- EDA Military RPAS AW Framework is based on/ takes into account:
  - European Military Airworthiness Requirements (EMARs) (*for military manned aircraft*)
  - Civil AW Requirements (EASA approach and JARUS work)
  - ATM requirements (EUROCONTROL)
<table>
<thead>
<tr>
<th>EDA Doc</th>
<th>EASA Doc</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMAR 21</td>
<td>Part 21</td>
<td>CERTIFICATION OF MILITARY AIRCRAFT AND RELATED PRODUCTS, PARTS AND APPLIANCES, AND DESIGN AND PRODUCTION ORGANISATIONS</td>
</tr>
<tr>
<td>EMAR 66</td>
<td>Part 66</td>
<td>MILITARY AIRCRAFT MAINTENANCE LICENSING</td>
</tr>
<tr>
<td>EMAR M</td>
<td>Part M</td>
<td>CONTINUING AIRWORTHINESS REQUIREMENTS</td>
</tr>
<tr>
<td>EMAR 145</td>
<td>Part 145</td>
<td>REQUIREMENTS FOR MAINTENANCE ORGANISATIONS</td>
</tr>
<tr>
<td>EMAR 147</td>
<td>Part 147</td>
<td>AIRCRAFT MAINTENANCE TRAINING ORGANISATIONS</td>
</tr>
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Current Military RPAS Certification Specifications (CS)

- **NATO**
  - STANAG 4671: *Unmanned Aerial Vehicles Systems AW Requirements*
  - STANAG 4702: *Rotary Wing Unmanned Aircraft Systems AW Reqs*
  - STANAG 4703: *Light Unmanned Aircraft Systems AW Reqs*

- **EDA**
  - EMACC: *European Military Airworthiness Certification Criteria*
Several Civil Stakeholders involved in UAS Regulatory Framework

- ICAO
- EASA
- FAA
- EUROCONTROL
- National Civil Aviation Authorities (CAA)
- JARUS (Joint Authorities for Rulemaking on Unmanned Systems)
- SESAR JU – Single European Sky ATM Research Joint Undertaking
- Aerospace Industry (ASD)
- ............
Recent Decisions in Europe: Riga Conference

- Drones must be treated as a new type of aircraft with proportionate rules based on risk of operation
- EU rules needed now
- Technologies and Standards to be developed for full integration
- Public acceptance is key to the growth of drone services
- The operator of a drone is responsible for its use
UAS in Civil Aviation

Current / Future Aviation Services

Aviation services today

Regulated civil aviation market

Other markets in the EU: link to aviation

Intermodal connection

Cargo transport

Just in time delivery

Oil rig delivery

Future aviation services

Regulated civil aviation market

Aerial inspection
Relay to remote areas

Exploration
Inspection
Delivery

Precision farming

Aerial inspection
Energy exploration

Other markets in the EU: link to aviation including civil drones

Intermodal connection
Track and station inspections
Security

Cargo transport
Last mile delivery

Just in time delivery
Traffic Information

Exploration
Oil rig delivery
UAS in Civil Aviation

Current / Future Aviation Operations

Aviation operations today

NO-DRONES

Future aviation operations

YES-DRONES

20,000 m
11,000 m
4,000 m
150 m

20,000 m
11,000 m
4,000 m
150 m

TELECOMMUNICATIONS
RELAY TO REMOTE AREAS

CARGO

INJECTIONS
FILMING
FARMING
UAS - Pillars of EASA Approach

**Operation centric**
- Consequences of loss of control highly dependent on operating environment

**Risk based**
- 3 categories: open, specific, certified
- Commercial as well as non commercial

**Smooth**
- No undue burden on the aviation system
EASA - RPAS Categories of Operation

**OPEN**
- Low risk
- No involvement of Aviation Authority
- Limitations (Visual line of sight, Maximum Altitude, distance from airport and sensitive zones)
- Flights over crowds not permitted except for harmless subcategory

**SPECIFIC**
- Increased risk
- Approval based on Specific Operation Risk assessment (SORA)
- Approved by NAA possibly supported by accredited QE unless approved operator with privilege
- Manual of Operations mandatory to obtain approval

**CERTIFIED**
- Regulatory regime similar to manned aviation
- Certified operations to be defined by implementing rules
- Pending criteria definition, EASA accepts application in its present remit
- Some systems (Datalink, Detect and Avoid, …) may receive an independent approval
Open Category: How Risk is Contained

- Identification
- Geo-limitation
- Safe Distance From People
- VLOS
- Pilot Competence Level
- Allowed Performance
- Limited Drone Zone
- "No-drone zone"
Open Category – Harmless sub-category

Specific harmless thresholds TBC with Impact Assessment Activity

<table>
<thead>
<tr>
<th>OPEN</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmless</td>
<td>&lt; 250 g</td>
<td></td>
</tr>
<tr>
<td>A0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>&lt; 25 Kg</td>
<td></td>
</tr>
</tbody>
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**Light / Very light market regulation**

- Subject to local restrictions
- Do not operate recklessly
- Follow operating instructions and do’s and don’ts
- Including FPV (First Person View)

Product Legislation

Instructions manual

Limited Drone Zone
- Geo-limitation System required
- Registration required
- Identification System required

Harmless

**“No-drone zone”**

Tree

Human

Houses
Open Category: A0 – A2 subcategories
Operational and Functional Requirements

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<thead>
<tr>
<th>Category</th>
<th>Limitation</th>
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<tr>
<td>OPEN</td>
<td>HL</td>
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<tr>
<td>A0</td>
<td>A1</td>
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**Product Legislation**

<table>
<thead>
<tr>
<th>Requirement</th>
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</thead>
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<tr>
<td>Compliance with Identification requirements</td>
<td>Product must comply with legislation</td>
</tr>
<tr>
<td>Compliance with no drone zones and special drone zones supported with automatic geo-limitation technology</td>
<td>Adequate pilot competence required</td>
</tr>
<tr>
<td>Observe minimum distance from uninvolved persons, fly only in VLOS and do not fly over crowds</td>
<td>Mandatory Registration</td>
</tr>
</tbody>
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**150 m Geo-limitation**

**Limited Drone Zone**
- CAT A1
- CAT A2

**Limited Drone Zone**
- Geo-limitation System required
- Registration required
- Identification System required

**Safe distance**

**Visual line of sight**
Specific Category
Specific Operation Risk Assessment (SORA) Elements

- Area of Operation
- Airspace
- UA Design
- Operational Procedure
- Pilot Competence
- Organizational Factors
- Effect on Environment

Risk Assessment

Improvements Needed

Operation Authorisation (OA)

Limitations
- Speed
- MTBM
- ...
Specific category – Standard Solutions

- **Area of Operation**
  - Population density during operation < number is TBD
  - Presence of crowds: no
  - Traffic overflown: no
  - ...

- **Airspace Template**
  - Nearest airport area > ... Km
  - Low level helicopter traffic: no
  - ...

- **UA Design**
  - Weight < ... Kg including payload
  - Dangerous materials: no
  - MTBCF (minimum time between critical failures) > ...
  - ...

- **Operations Template**
  - Max flight altitude < ...
  - Max speed: ...
  - Operation duration, number of operations forecasted, ...
Other Standard Activities

- **Industrial Inspections**
  - Power centrals *(Nuclear, Chemical, etc.)*
  - Mining
  - Naval
  - Aviation
  - …etc.

- **Precision farming**
  - Monitoring
  - Fertilizer spreading
  - …

- **Infrastructures inspections**
  - Railways
  - Power lines
  - Fuel/Gas pipe lines
  - …

- …
Certified Category

Implementing rules included in existing rules for manned aviation

Drone and components
- Type Certificates (Full / Restricted)
- Certificates of Airworthiness
- European Technical Standard Order Approvals (ETSO) (option)

Organisations
- Design Organisation Approval
- Production Organisation Approval
- Maintenance Organisation Approval
- Training Organisation Approval

Personnel
- Licensed pilot
- Remote Operator Certificate (ROC)

Certification Specifications
- Safety Objectives
- Complemented by Technical Standards
- Standard for Operational aspects
- Standard for Licencing aspects
EASA “Prototype” Rules

- “Prototype” Commission Regulation on Unmanned Aircraft Operations issued on 22 Aug 2016
- Presents a ‘prototype’ regulation for the operation of unmanned aircraft in the ‘open’ and ‘specific’ categories. Its sole purpose is to inform and consult stakeholders in view of the ongoing negotiations with the Parliament and the Council on the review of EC Regulation (EC) No 216/2008.
- Not constitute any formal commitment on behalf of EASA nor of the European Commission.
UAS Regulatory AW Framework - Challenges

- Important differences between UAS and manned aircraft
  - C2 Link
  - RPS
- Requirements from different domains interact and should be taken into account for developing a robust regulatory framework
  - Airworthiness
  - Air Traffic Management
  - Telecommunications
  - Cyber security, etc.
## Military - Civil RPAS Categorization Comparison

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* Categorization procedures not finalized

** Subcategories are included
UAS Aviation Regulatory Framework - Challenges

• Harmonization between civil and military requirements and systems are needed in order to achieve:
  • Cost savings in design and production of UAS with common specs and standards
  • UAS Dual use by both civil and military stakeholders
  • Smooth integration of civil/military UAS into a “Common Single Sky” together with manned aircraft
Airworthiness Regulatory Framework for Military – Civil RPAS

Thank you for your attention

QUESTIONS - DISCUSSION