Overview of European Union Guidelines and Regulatory Framework for Drones in Aviation in the context of the introduction of automatic and autonomous flight operations in Urban air mobility

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Academic Experience

✓ BSc: Mechanical Engineering

✓ MSc: Energy System Engineering

➢ Studying Ph.D. in: Industrial Engineering and operations research
   Thesis title: Digital twin based certification for smart industry application
The research topics and current project

AURORA’s Unmanned Aerial Vehicles

- 10 kg UAV
- 75 kg UAV
- 600 kg rotorcraft

8 partners in 5 EU states

Aurora demonstration and Potential Locations

sAfe Urban aiR mObility for euRopeAn citizens
Abstract

EU Member States:
drones less than 150kg

European Aviation Safety Agency:
drones more than 150kg

EASA:
drones in all sizes and weights

31 December 2020

EASA AI roadmap

Regulation 2019/945 for technical requirements

Regulation 2019/947 for operations

National Aviation Authorities

European Aviation Safety Agency

OVERVIEW OF EU REGULATION
Drones Operational Categories

**Open**
- low-risk operations
- Three sub-categories (A1, A2, and A3)
- No operational authorization or declaration required by operator before start of flight
- VLOS, 25kg MTOM, 120m AGL
- Not carry dangerous goods and no dropping of any material
- Not over assemblies of people
- 5 different C-classes for Open category flights

**Specific**
- Increased risk
- Declaration suffices if Standard Scenario (STS-x)
- STS-01 (VLOS - maximum height 120m and MTOMs 25kg and Size less than 3m)
- STS-02 (BVLOS-maximum height 120m and MTOMs 25kg and Size less than 3m)
- Operational authorization required based on SORA or PDRA
- LUC self-authorization

**Certified**
- The highest level of risk
- Always need to be certified.
- The UAS operator will need an air operator approval issued by the competent authority, and the remote pilot is required to hold a pilot license.
- The safety approach will be very similar to manned aviation, and almost all the aviation regulations will need to be amended.
- The UAS has a dimension of 3 m or more in the operation involves flying over assemblies of people
- The transport of people
- The transport of dangerous goods if the payload is not in a crash-protected container.
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## Operational risk assessment for drones in specific category

<table>
<thead>
<tr>
<th>STS#</th>
<th>Edition/ date</th>
<th>UAS characteristics</th>
<th>BVLOS/ VLOS</th>
<th>Overflown area</th>
<th>Maximum range from remote pilot</th>
<th>Maximum height</th>
<th>Airspace</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-01</td>
<td>June 2020</td>
<td>Bearing a C5 class marking (maximum characteristic dimension of up to 3 m and MTOM of up to 25 kg)</td>
<td>VLOS</td>
<td>Controlled ground area that might be located in a populated area</td>
<td>VLOS</td>
<td>120 m</td>
<td>Controlled or uncontrolled, with low risk of encounter with manned aircraft</td>
</tr>
<tr>
<td>STS-02</td>
<td>June 2020</td>
<td>Bearing a C6 class marking (maximum characteristic dimension of up to 3 m and MTOM of up to 25 kg)</td>
<td>BVLOS</td>
<td>Controlled ground area that is entirely located in a sparsely populated area</td>
<td>2 km with an AO†† 1 km, if no AO</td>
<td>120 m</td>
<td>Controlled or uncontrolled, with low risk of encounter with manned aircraft</td>
</tr>
</tbody>
</table>

### List of the predefined risk assessments (PDRA#s)

<table>
<thead>
<tr>
<th>PDRA#</th>
<th>Edition/ date</th>
<th>UAS characteristics</th>
<th>BVLOS/ VLOS</th>
<th>Overflown area</th>
<th>Maximum range from remote pilot</th>
<th>Maximum height</th>
<th>Airspace</th>
<th>AMC# to Article 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDRA-S01</td>
<td>1.0/July 2020</td>
<td>Maximum characteristic dimension of up to 3 m and MTOM of up to 25 kg</td>
<td>VLOS</td>
<td>Controlled ground area that might be located in a populated area</td>
<td>VLOS</td>
<td>120 m</td>
<td>Controlled or uncontrolled, with low risk of encounter with manned aircraft</td>
<td>AMC4</td>
</tr>
<tr>
<td>PDRA-S02</td>
<td>1.0/July 2020</td>
<td>Maximum characteristic dimension of up to 3 m and MTOM of up to 25 kg</td>
<td>BVLOS</td>
<td>Controlled ground area that is entirely located in a sparsely populated area</td>
<td>2 km with an AO 1 km, if no AO</td>
<td>120 m</td>
<td>Controlled or uncontrolled, with low risk of encounter with manned aircraft</td>
<td>AMC5</td>
</tr>
<tr>
<td>PDRA-G01</td>
<td>1.1/July 2020</td>
<td>Maximum characteristic dimension of up to 3 m and typical kinetic energy of up to 34 kJ</td>
<td>BVLOS</td>
<td>Sparsely populated area</td>
<td>If no AO, up to 1 km 150 m (operational volume)</td>
<td>Uncontrolled, with low risk of encounter with manned aircraft</td>
<td>AMC2</td>
<td></td>
</tr>
<tr>
<td>PDRA-G02</td>
<td>1.0/July 2020</td>
<td>Maximum characteristic dimension of up to 3 m and typical kinetic energy of up to 34 kJ</td>
<td>BVLOS</td>
<td>Sparsely populated area</td>
<td>N/a</td>
<td>As established for the reserved airspace</td>
<td>As reserved for the operation</td>
<td>AMC3</td>
</tr>
</tbody>
</table>

** STS:** Standard Technical Specification  
** PDRA:** Predefined Risk Assessment  
** AMC:** Acceptable Means of Compliance

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### Other process (e.g. category certified ) or new modified ConOps

- **Step 1:** Concept of Operations (ConOps) description
- **Step 2:** Determination of the UAS intrinsic ground risk class (GRC)
- **Step 3:** Final GRC determination
- **Step 4:** Determination of the initial air risk class (ARC)
- **Step 5 (optional):** Application of strategic mitigations to determine the final ARC
- **Step 6:** Tactical Mitigation Performance Requirement (TMPR) and robustness levels
- **Step 7:** Specific Assurance and Integrity Level (SAIL) determination
- **Step 8:** Identification of operational safety objectives (OSOs)
- **Step 9:** Adjacent area / airspace considerations
- **Step 10:** Comprehensive safety position: Are the mitigations and objectives required by the SORA met with a sufficient level of confidence?
Autonomous vs Automatic

**Autonomous UAV**

With the help of artificial intelligence, autonomous UAS must cope with unforeseen conditions and unpredictable emergencies to conduct a safe flight without the pilot's intervention.

**Automatic UAV**

Automatic UAS flies on pre-determined routes, and the remote pilot intervenes in case of unforeseen events not programmed in pre-determined operation.
A human-centric approach to AI in aviation

Artificial Intelligence Roadmap
A human-centric approach to AI in aviation

EC Ethical Guidelines
- Accountability
- Technical robustness and safety
- Oversight
- Privacy and data governance
- Non-discrimination and fairness
- Transparency
- Societal and environmental well being

EASA Trustworthy AI building-blocks
- Learning Assurance
- AI Explainability
- AI Safety Risk Mitigation

OVERVIEW OF EU REGULATION
Conclusion

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European Aviation Safety Agency: drones more than 150kg

2020

2023

EASA: drones in all sizes and weights

National Aviation Authorities

EASA: drones in all sizes and weights

OVERVIEW OF EU REGULATION
Thank you for your attention!

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