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ULTRA

Unmanned Aerial Systems in European Airspace

Thematic Priority: AAT.2012.7-25. Assessment of the potential insertion of unmanned aerial system in the air transport system

Instrument: Coordination and Support Actions (CSA)

D1.2 – Proposed set of actions to fill the gaps in the existing regulatory framework

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Table of Contents

1. INTRODUCTION 5

1.1. Project Objectives 5

1.2. Background 6

1.3. Purpose of the Document 8

1.4. Document Structure 8

1.5. References 8

1.6. Glossary 15

2. SUMMARY OF REGULATORY & STANDARDIZATION GAPS 20

3. RECOMMENDATIONS FOR LIGHT RPAS REGULATION 24

3.1. Initial Considerations and Recommendations 24

3.2. Recommendations for the Regulation of Light RPAS enabling Immediate and Short Term Operations ("Quick Win") 27

3.2.1. Classification scheme 27
3.2.1.1. Aircraft categories 27
3.2.1.2. RPA mass threshold(s) 28
3.2.2. Airworthiness 28
3.2.2.1. Initial Airworthiness 28
3.2.2.2. Approval of Design and Production Organizations 32
3.2.2.3. Continuing Airworthiness 33
3.2.3. Flight Crew Licensing and Training 34
3.2.4. Operations and Operators 37
3.2.4.1. Operations 37
3.2.4.2. Operators 40

3.3. Recommendations for the complete Regulation of Light RPAS ("Longer Term") 43

3.3.1. Classification scheme 43
3.3.2. Airworthiness 45
3.3.2.1. Initial Airworthiness 45
3.3.2.2. Approval of Design and Production Organizations 47
3.3.2.3. Continuing Airworthiness 48
3.3.3. Flight Crew Licensing and Training 50
3.3.4. Operations and Operators 52
3.3.4.1. Operations 52
3.3.4.2. Operators 55

This project has been carried out under a contract awarded by the European Commission

3.4. Summary of ULTRA Recommendations for Regulatory Gaps..... 56

4. CONCLUSIONS 59

List of Figures

Figure 1-1: ULTRA work logic..... 7

Figure 1-2: ULTRA Consortium 7

Figure 3-3: Example of possible classification of RPAS according to levels of autonomy (source: elaboration based on ASTRAEA (left) and ALFUS (right) models)..... 43

List of Tables

Table 3-1: Main advantages of MTOM = 20 Kg and MTOM = 25 Kg as mass threshold for airworthiness certification..... 29

Table 3-2: Summary of ULTRA Recommendations for Regulatory & Standardization Gaps..... 58

This project has been carried out under a contract awarded by the European Commission

1. INTRODUCTION

1.1. Project Objectives

The overall objectives of the ULTRA project are:

- To provide a comprehensive set of recommendations for the incremental insertion of civil Light RPAS (RPA with operating mass up to 150 Kg) in the European airspace in the short-term (i.e. within 5 years from now)
- To provide specific recommendations for selected “Use Cases” to be explored as “quick win” business cases.
- Highlight what needs to be done in order to unlock the full potential of the civil Light RPAS market in the long-term (i.e. 10-15 years from now)

These overall objectives are further divided into the following technical objectives in order to address the European Commission expectations for this project:

- Current RPAS status:

  Analyze current and past work relative to civil RPAS, including existing best practices – regulatory authorities and qualified entities (certification & operations), commercial (manufacturers & RPAS operators) and non-commercial (research, scientific, governmental non-military) –, and propose a starting point for Light RPAS operations in the short term.

- Realistic business model and short term, applications:

  Develop a business model for civil Light RPAS applications. Explore short-term, high value applications, and analyze their sustainability and level of impact on European industry and society.

- Social acceptance and building trust with the regulators:

  Perform an in-depth analysis on how to overcome the barriers and mistrust of (Light) RPAS by the general public. Follow a step-by-step approach to build trust between the (Light) RPAS industry and the regulators.

- Foster innovation in and support SMEs access to market:

  Foster the European innovation in terms of aviation automation and provide a path which facilitates access to market for European SMEs.

- Set of Recommendations:

  Develop recommendations to support a sustainable civil Light RPAS market in the short-term and highlights the steps needed in order to unlock the full potential of the (Light) RPAS market in the long-term.

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1.2. Background

The ULTRA project is an 18-month duration "*Coordination and Support Action (CSA)*" funded under the call *FP7-AAT-2012-RTD-1* of the *Transport* (including "Aeronautics") Cooperation Theme of the European Commission (EC) 7th Framework Programme (FP7) to address the activity: *AAT.2012.7-25. Assessment of the potential insertion of unmanned aerial system in the air transport system*, for which the following content, scope and expected impact were established by the EC:

Content and scope: *The study should establish the minimum requirements in terms of standards equipments and regulations to allow the safe insertion of UAS in the civil airspace. It should also anticipate the steps required for the certification and the validation of the insertion. In the light of this, the path to exploitation will be investigated: market trends, adaptation of infrastructures and investments, obstacles to social acceptance. The consortium should gather a representative group of stakeholders including among others manufacturers, regulators, air navigation service providers, and customers*.

Expected impact: *Proposals should demonstrate contributing to analyse and assess the innovation steps needed to allow the insertion of Unmanned Aerial Systems (UAS) for civil application in the air transport system*.

To address these requirements, with the focus on Light RPAS, the ULTRA Consortium defined the project objectives indicated in sec. 1.1, and organized the work in the following work packages:

- WP1 – *Regulatory and Certification Base*
    - Identification of gaps and new/modified regulations within the existing regulatory framework
    - Proposed set of actions to fill the gaps in the existing regulatory framework
- WP2 – *Adaptation of Infrastructures*
    - State-of-the-art report of civil RPAS solutions and enabling technologies
    - Time-phased alternative solutions for all equipment and infrastructure enablers
- WP3 – *Safety and Social Acceptance*
    - Safety aspects of civil (Light) RPAS operations
    - The social dimension of civil (Light) RPAS operations
    - Impact of (Light) RPAS (on society)
- WP4 – Business Case and Impact on European Industry
    - Most relevant use cases for civil (Light) RPAS in Europe in the 2013-2014 timeframe
    - Civil (Light) RPAS applications in Europe: Deployment plan and economic sustainability of the business case
- WP5 – Conclusions and Recommendations
    - Project Final Report
    - Dissemination activities and material, and project website
- WP6 – Coordination

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As indicated in the "project objectives" (sec. 1.1), one of the main objectives is *to provide specific recommendations for selected "Use Cases" to be explored as "quick win" business cases*. Therefore, the work developed by the different work-packages will feed into the "selected use cases" in order to provide specific recommendations for them from the different key aspects addressed in the project, and support the development of the corresponding business cases. This work logic is depicted in Figure 1-1.

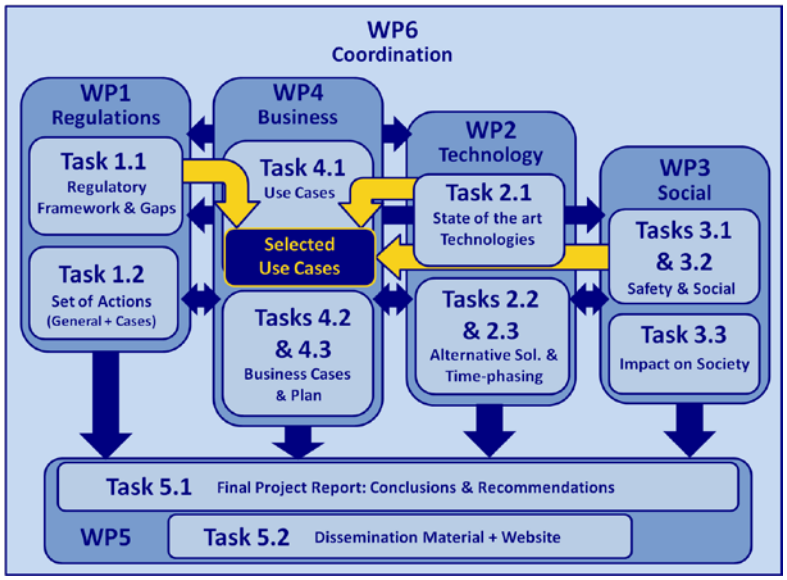

Figure 1-1: ULTRA work logic

The project started in June 2012 and its duration is 18 months. The ULTRA Consortium gathers a representative group of stakeholders including large and small organizations, as illustrated in Figure 1-2.

Figure 1-2: ULTRA Consortium

It is worth noting that the ULTRA Consortium has been participating in the **European RPAS Study Group (ERSG)** of the European Commission (see ULTRA D1.1 [ref. R.5])

1.3. Purpose of the Document

The main objective of this document is to provide a **set of recommendations to overcome those regulatory and standardization "gaps" identified in ULTRA deliverable D1.1** [ref. R.5] in order to enable Light RPAS operations.

Following the overall ULTRA project approach indicated in sec. 1.1 this document provides recommendations for:

- **Short-term operations**, thus **enabling the selected "Use Cases"** identified as "quick win" business cases (identified and analyzed in ULTRA WP4).
- **Long-term operations**, highlighting what needs to be done in the regulatory and standardization domain to **unlock the full potential of the civil Light RPAS market** in the long-term (i.e. 10-15 years from now)

It must be noted that the work developed under **WP1**, of which this document is a product, will deal **only with the Aviation Safety aspects**, leaving to WP3 the work on other legal and social aspects (e.g. liability, insurance, privacy & data protection, security, public acceptance, etc.)

1.4. Document Structure

This report has been structured as follows to clearly address the abovementioned report objectives:

- Chapter 1: *Introduction*. It provides a description of project objectives and background, this document purpose, and indicates the references and acronyms list used throughout the document.
- Chapter 2: *Summary of regulatory & standardization gaps*. It summarizes the main gaps identified in ULTRA D1.1 [ref. R.5] regarding the regulation and standards applicable to Light RPAS.
- Chapter 3: *Recommendations for Light RPAS Regulation.* It provides initial considerations and general recommendations, then recommendations for the regulation of Light RPAS enabling immediate and short term operations ("Quick Win"), recommendations for the complete ("longer term") regulation of Light RPAS, and finally a tabulated summary with the regulatory & standardization gaps and the corresponding references (identifiers) of the related ULTRA recommendations.
- Chapter 4: *Conclusions.* It provides a summary and concluding remarks.

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R.104 ASTRAEA website: http://www.astraea.aero

R.105 Example of European SME manufacturing small multi-rotor RPAS and claiming to hold an ISO 9001 certificate: http://www.airrobot.com/index.php/legal-details.html (retrieved 06/05/2013)

R.106 Example of SME manufacturing small fixed wing RPAS and claiming to hold an ISO 9001 certificate: http://www.cropcam.com (retrieved 06/05/2013)

R.107 Example of European SME manufacturing small fixed wing RPAS and claiming to hold a national recognition of quality and maturity: http://www.sensefly.com/about/company-profile.html (retrieved 06/05/2013)

R.108 Example of European SME manufacturing avionics (GNC) for Light RPAS and claiming to hold an ISO 9001 certificate: http://www.uavnavigation.com/?q=company/quality (retrieved 06/05/2013)

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1.6. Glossary

ACAS	Airborne Collision Avoidance System
ADREP	(ICAO) Accident/Incident Data Reporting
ADS-B	Automatic Dependent Surveillance-Broadcast
ADT	Airborne Data Terminal
AIP	Aeronautical Information Publication
AMC	Acceptable Means of Compliance
AM(R)S	Aeronautical Mobile (Route) Service
ANS	Air Navigation Services
AOC	Aircraft Operator Certificate
ARC	(FAA) Aviation Rulemaking Committee
ASBU	Aviation System Block Upgrades
ASTRAEA	Autonomous Systems Technology Related Airborne Evaluation & Assessment
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
ATO	Approved Training Organization
ATPL	Air Transport Pilot Licence
ATS	Air Traffic Services
AW	Aerial Work
AW	Airworthiness
BIT	Built-In Test
BRLOS	Beyond Radio Line of Sight
BVLOS	Beyond Visual Line of Sight
C2	Command and Control
C3	Communication, Command and Control
CAA	Civil Aviation Authority
CAMO	Continuing Airworthiness Management Organization
CASA	(Australia) Civil Aviation Safety Authority
CAT	Commercial Air Transport
CEH	Complex Electronic Hardware
CEHS	Complex Electronic Hardware and Software
CEPT	Conference of European Postal and Telecommunications Administrations
CFMS	Complex Flight Management System
CFR	(US) Code of Federal Regulation
CNS	Communications/Navigation/Surveillance
COA	(FAA) Certificate of Authorization or Waiver
CofA	Certificate of Airworthiness

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CPL	Commercial Pilot Licence
CS	(EASA) Certification Specification
D&A / DAA	Detect & Avoid / Detect and Avoid
DME	Distance Measuring Equipment
DOA	Design Organization Approval
DoD	(US) Department of Defense
DoW	Description of Work
DUO	Designated Unmanned Aerial Vehicle Operator
EASA	European Aviation Safety Agency
EC	European Commission
ECAC	European Civil Aviation Conference
ECCAIRS	European Coordination Centre for Accident and Incident Reporting Systems
EDA	European Defence Agency
EFTA	European Free Trade Association
ELA	European Light Aircraft
ELOS	Equivalent Level of Safety
EMAR	European Military Airworthiness Requirements
ERSG	European RPAS Steering Group
ESA	European Space Agency
EU	European Union
EUROCAE	European Organization for Civil Aviation Electronics
EUROCONTROL	European Organisation for the Safety of Air Navigation
EVLOS	Extended Visual Line of Sight
FAA	(US) Federal Aviation Administration
FCL	Flight Crew Licensing
FCT	Flight Crew Training
FMS	Flight Management System
FOD	Foreign Object Damage
FSS	Fixed-Satellite Service
FSTD	Flight Simulation Training Device
FP	Framework Programme
GA	General Aviation
GAT	General Air Traffic
GCS	Ground Control Station
GDT	Ground Data Terminal
GM	Guidance Material
GNC	Guidance Navigation and Control
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HALE	High Altitude Long Endurance
ICAO	International Civil Aviation Organization
law.	In accordance with
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
INS	Inertial Navigation System
IR	Implementing Rules
ISR	Intelligence, Surveillance and Reconnaissance

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ITU	International Telecommunication Union
JARUS	Joint Authorities for Rulemaking on Unmanned Systems
JPDO	(US) Joint Planning and Development Office
KOM	Kick-Off Meeting
LoA	Level(s) of Autonomy
LoC	Loss of Communication
Lrs	Launch & Recovery System
LSA	Light Sport Airplanes
LTA	Lighter Than Air
LUAS	Light Unmanned Airplane System
LURS	Light Unmanned Rotorcraft System
MAA	Military Aviation Authority
MALE	Medium Altitude Long Endurance
MASPS	Minimum Aviation System Performance Standard
MIDCAS	Mid-Air Collision Avoidance System
MoD	Ministry of Defence
MoM	Minutes of Meeting
MOPS	Minimum Operational Performance Standards
MRO	Maintenance, Repairs and Overhauls
MS	(EU) Member State
MTOM	Maximum Take Off Mass
N/A	Not Available / Not Applicable
NAA	National Aviation Authority
NAFTA	North American Free Trade Agreement
NAS	(US) National Airspace
NATO	North Atlantic Treaty Organization
NCC	Non-Commercial operations with Complex motor-powered aircraft
NCO	Non-Commercial operations with Other-than-complex motor-powered aircraft
NOTAM	Notice to Airmen
NPA	(EASA) Notice of Proposed Amendment
NPRM	(FAA) Notice of Proposed Rulemaking
OAT	Operational Air Traffic
OCCAR	*Organisation Conjointe de Coopération en matière d'ARmement*
OPS	Operations
OIFR	Operational Instrument Flight Rules
OVFR	Operational Visual Flight Rules
PANS	Procedures for Air Navigation Services
PBN	Performance-Based Navigation
PIC	Pilot In Command
POA	Production Organization Approval
PPL (A)/(H)	Private Pilot Licence for Airplane/Helicopter
PSR	Primary Surveillance Radar
PtF	Permit to Fly
R&D	Research and Development
RTD	Research and Technological Development
RF	Radio Frequency
RLOS	Radio Line of Sight
RNAV	Area Navigation

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ROC	RPAS Operator Certificate
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft System
RPS	Remote Pilot Station
R/T	Radio Telephony
RVSM	Reduced Vertical Separation Minima
SARPs	Standard and Recommended Practices
SATCOM	Satellite Communications
SC	Special Condition
SC	Sub-Committee
SERA	Standardised European Rules of the Air
SES	(EU) Single European Sky
SESAR	Single European Sky ATM Research
SET	Single-Engine Turboprop
SF	State Flights
SFAR	(FAA) Special Federal Aviation Regulation
SG	Sub-Group
SME	Small and Medium(-sized) Enterprise
SMI	Small and Medium(-sized) Industry
SMS	Safety Management System
SP	Synthetic Pilot
SPA	(Operations requiring) Specific Approvals
SPE	Single Piston Engine
SPO	Specialised Operations
SPR	Safety and Performance Requirements
STANAG	(NATO) Standard Agreement
STC	Supplemental Type Certificate
SUPP	(ICAO Regional) Supplementary Procedures
SW	Software
SWaP	Size, Weight and Power
TC	Type Certificate
TMG	Touring Motor Glider
TOR	Terms of Reference
TRL	Technology Readiness Level
TSO	Technical Standard Order
UA	Unmanned Aircraft
UAV	Unmanned Aerial Vehicle
UAS	Unmanned Aircraft/Aerial System
UASSG	(ICAO) UAS Study Group
UK	United Kingdom
UHF	Ultra High Frequency
ULTRA	Unmanned Aerial Systems in European Airspace
US / USA	United States / United States of America
USAR	UAV System Airworthiness Requirements
VFR	Visual Flight Rules
VHF	Very High Frequency
VLA	Very Light Airplane
VLL	Very Low Level

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VLOS	Visual Line of Sight
VLR	Very Light Rotorcraft
VMC	Visual Meteorological Conditions
VOR	VHF Omni-directional Range
WG	Working Group
WP	Work Package
WPL	Work Package Leader
WRC	World Radio Conference

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2. SUMMARY OF REGULATORY & STANDARDIZATION GAPS

In ULTRA deliverable D1.1 – *Identification of gaps and new/modified regulations within the existing regulatory framework* [ref. R.5] the following main gaps were identified for the regulation and standardization of Light RPAS:

- *General (overall)* gaps:
  - **Harmonization in regulations and standards**:
    - **RG-1: Harmonization in regulations and standards at European level**.

      The fact that the Basic Regulation [ref. R.20] left Light RPAS outside of its scope has derived in a **fragmented situation in Europe with regard to civil Light RPAS regulation** by the EASA Member States. Furthermore, **significant differences** can be found when comparing the regulatory material for Light RPAS that has been already produced by a few European countries, thus highlighting the **need for harmonization in order not to create a major showstopper for the growth of a European Light RPAS market.**

    - **RG-2: Harmonization in regulations and standards at International level**

      A lack of harmonization in the regulation of Light RPAS is also currently present at global level, which constitutes a major general showstopper for the growth of the Light RPAS industry, especially for the civil market, as the different national / regional requirements might pose a major **difficulty to export and operate RPAS**.

    - **RG-3: Civil-Military Harmonization**

      Most RPAS can be considered **dual (civil-military) technology**, and consequently it is of high importance for the RPAS industry to have the highest degree of commonality in civil-military safety requirements and **avoid having significantly different sets of requirements for the same type of RPAS** depending on whether they are used for civil or military applications.

  - **RG-4: Globally agreed classification scheme for RPAS**

    The concepts of category, class and type of aircraft defined for manned aviation can be considered also applicable to RPAS. However, within an aircraft category (e.g. airplane, rotorcraft …) the primary method used in manned aviation for categorizing aircraft for regulatory purposes is based on the maximum take-off weight (mass) of the aircraft. However the **RPA mass is not necessarily the only or most representative and suitable characteristic for RPAS characterization**, nevertheless it is being already considered in current Light RPAS regulations, but there is already a **fragmented view on the mass segmentation** to be applied.

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- **RG-5: Safety-related data and limited familiarization of authorities (and other stakeholders) with RPAS**

  RPAS involve technologies and concepts that are generally unknown or **not sufficiently known by the authorities** (in particular the civil ones) and other stakeholders, which in addition to the **lack of safety-related data**, makes clear the **need for demonstration activities involving authorities and other stakeholders**.

- "*Airworthiness*" gaps:
  - **RG-6: "Harmonized approach" for Initial Airworthiness of Light RPAS**

    The development of new regulations at European nation level to address Light RPAS airworthiness certification is showing already **significant differences in the approaches being followed** by the different European nations. Therefore, in line with the general need for regulatory harmonization (regulatory gaps RG-1 and RG-2), there is a specific **need for a "harmonized" approach on airworthiness certification processes and approvals** ("Part 21-like") **for Light RPAS**

  - **RG-7: "Harmonized approach" for Continuing Airworthiness of Light RPAS**

    Likewise "Initial Airworthiness", there is also a **need for a "harmonized" approach on continuing airworthiness processes and approvals** ("Part M/145/147/66-like") **for Light RPAS**.

  - **RG-8: "Harmonized" Safety Objectives applicable to Light RPAS in their different categories**

    The definition of **proportionate safety objectives and assessment criteria for (Light) RPAS** at an early stage of the rule-making process is **paramount for the development of the (Light) RPAS industry**, since it has a direct and significant impact on the (Light) RPAS design (e.g. redundancies and complexity) and the related certification effort (amount of substantiation effort and economic repercussions), as well as the overall safety level of (Light) RPAS operations. The importance of the issue of setting safety objectives for Light RPAS has been underestimated up to now and it cannot be circumvented before establishing requirements for airworthiness certification (for those Light RPAS subject to such certification).

  - **RG-9: "Harmonized" Airworthiness Codes for Light RPAS**

    So far the only available and recognized airworthiness codes for RPAS are those developed on the military side by NATO (e.g. STANAG 4703 [ref. R.63] and the STANAG 4738 [ref. R.64] for Light RPAS). Therefore, on the civil side there is a need for recognized airworthiness codes, and in particular, a **need for "harmonized" (recognized across Europe) airworthiness codes for Light RPAS**.

  - **RG-10: Harmonized requirements for Light RPAS Design, Production and Maintenance Organisations**

    Requirements like those being specified for DOA/POA in Part 21 (and Part-M/145 for MRO related ones) are deemed too demanding for organizations undertaking design / production (or MRO) activities on Light RPAS. Thus, **"harmonized" and more proportionate**

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requirements (than those for manned aviation) must be defined for **organizations undertaking design / production / MRO** activities on **Light RPAS subject to airworthiness certification**.

- "*Flight Crew Licensing & Training*" gaps:
  - **RG-11: "Harmonized" requirements for Flight Crew Licensing & Training**

    Since RPAS have been used mostly in the military domain it is there were most sets of requirements on remote pilot licensing and training can be found, even at international level (e.g. STANAG 4670). On the civil side, however, by comparing the few existing regulatory material for Light RPAS, it is clear that there is already a diversity of requirements. Therefore there is a need for **"harmonised" requirements for flight crew licensing and training**.

  - **RG-12: "Harmonized" requirements for Flight Simulation Training Devices (FSTD)**

    Similarly to manned aviation, training of remote pilots generally requires the use of a "Flight Simulation Training Device (FSTD)". Designing a RPAS FSTD is in general much simpler and cost-effective to achieve than for manned aircraft; furthermore, a FSTD in the case of Light RPAS can be reduced to a tool / SW application installed in the RPS or in a PC. However, since there is a lack of "harmonized" standards for RPS design there is also a **lack of "harmonized" requirements for the qualification / approval of the corresponding RPAS FSTD**.

  - **RG-13: "Harmonized" requirements for Approval of Training Organizations (ATO)**

    As in the case of design / production / MRO-related organizations (see RG-10) in manned aviation training organizations for flight crews have to be approved by the relevant authority, and the same must in principle apply to (Light) RPAS. But there are currently **no "harmonized"** (recognized across Europe) **requirements established for training organizations of (Light) RPAS flight crews**.

- "*Operations, Use of Airspace and Launch & Recovery Sites*" gaps:
  - **RG-14: "Harmonized" requirements and procedures for RPAS operations**

    RPAS introduce new concepts of operations for which **new requirements and procedures are required**, in particular for Very Low Level (VLL) operations, including Visual Line of Sight (VLOS) and Extended Visual Line of Sight (E-VLOS) operations, and Beyond Visual Line of Sight (BVLOS) operations. Also, some **"Rules of the Air" and corresponding procedures might need to be revised** (in particular those for VFR and IFR). Paramount is indeed, the RPAS compliance by alternative means (D&A solutions) with the manned aviation principle of **"see and avoid"** in order to allow RPAS to operate in non-segregated airspace. Requirements for operations of Light RPAS are already being included in the existing national regulations, but in most cases only requirements for VLOS operations are included. Therefore there is a **need for "harmonized" requirements for all types of (Light) RPAS operations**.

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- **RG-15: "Harmonized" requirements for avoidance of collision with other air traffics**

  The lack of a pilot on board the aircraft makes current RPAS unable to comply with the "rules of the air" governing the operations in non-segregated airspace, and more specifically with the "see and avoid" principle . Thus, "detect and avoid" solutions must be developed and show compliance with the applicable requirements to the relevant aviation authorities. However **"harmonized" requirements and standards for these "detect and avoid" solutions are still to be established** in order to make possible operations of (Light) RPAS in non-segregated airspace, beyond the visual range of the flight crew and following aviation flight rules (VFR / IFR).

- **RG-16: "Harmonized" requirements for avoidance of collision with terrain / obstacles**

  Like in the case of avoidance of collision with other air traffics (RG-15), the lack of a pilot on board the aircraft is a challenge for the avoidance of collision with terrain or obstacles. Thus, "detect and avoid" solutions must be developed and show compliance with the applicable requirements to the relevant aviation authorities. However, for operations beyond the visual range of the flight crew, **"harmonized" requirements and standards for these "detect and avoid" solutions are still to be established**.

- **RG-17: "Harmonized" requirements for avoidance of hazardous weather**

  Avoidance of hazardous weather is another increased challenge due to the remote location of the pilot in a RPAS. Likewise the avoidance of collision with other air traffics (RG-15) and with terrain / obstacles (RG-16), **"harmonized" requirements and standards for these "detect and avoid" solutions are still to be established**.

- **RG-18: "Harmonized" requirements for communications (C3)**

  The nature of RPAS presents specific issues like those related to the communications for command and control of the RPA from the RPS (C2, including "detect and avoid" data, if applicable) and for the voice/data transmission between the remote pilot and the ATC (C3 = C2 + ATC comm.), like C3 performance requirements (availability, continuity, integrity and timeliness – latency), Loss of Communications (LoC) procedures, and dedicated radiofrequency spectrum and bandwidth. Currently there is a **lack of "harmonized" requirements and standards to address these C3 issues**.

- **RG-19: "Harmonized" requirements for Operators**

  A number of civil operators of Light RPAS are already being approved at national level in accordance with the national regulations being established. However the differences in such regulations suggest the need for **"harmonized" requirements for the approval of Light RPAS operators.**

ULTRA recommendations to contribute overcoming these gaps are proposed in section 3.

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3. RECOMMENDATIONS FOR LIGHT RPAS REGULATION

3.1. Initial Considerations and Recommendations

The EU, through the EC, is decided to contribute to unleash the potential of Light RPAS for civil operations. For this, the **first priority is to achieve a safe integration of RPAS into the European aviation system as soon as possible**, which among other aspects requires to take regulatory actions, as identified by the European RPAS Steering Group (ERSG) in the development of their RPAS Roadmap, and further analyzed in ULTRA D1.1 [ref. R.5] for Light RPAS.

Furthermore, in the EC Staff Working Document (SWD) on RPAS [ref. R.28] it is stated that: «*A commercial market for **light RPAS flying in uncontrolled airspace** (mainly in Visual Line of Sight - VLOS) is already emerging, although under difficult conditions, supported by the dynamism of a number of entrepreneurs and start-ups. In this segment safety is a critical factor as well and must be demonstrated to provide the necessary confidence for the authorities and investment from industry. **Clear rules, mainly on the pilots and on the operations, are urgently needed**, considering especially, that so far no more than 10 EU Member States have published rules for RPAS operations. **Supporting this market segment by developing appropriate safety regulation would be a quick win**.*»

Thus, **safety regulations to enable Light RPAS operations in uncontrolled airspace** (mainly under VLOS) is **considered a "quick win"** by the EC, and consequently this aspect is **among the priorities of EC** efforts on RPAS.

However, as it is well known within the European Unmanned Aviation community (and described in ULTRA D1.1 [ref. R.5]) Regulation (EC) No 216/2008 [ref. R.20] *mandates EASA to regulate RPAS when used for civil applications and with an operating mass of 150 Kg or more*. This means that *experimental or amateur build RPAS, military and non-military governmental RPAS flights, **civil RPAS below 150 Kg** **[Light RPAS]** as well as model aircraft **are regulated by individual Member States** of the European Union* (see ref. R.94).

Therefore, the **role of the EC on regulating Light RPAS is rather to encourage and support**[1] the required activities to achieve the goal of having the regulations in place but the **responsibility is on the Member States**. As discussed in D1.1. [ref. R.5], this European regulatory singularity of dividing responsibilities between EC/EASA and the Member States has created a **fragmented situation in Europe** with regard to the regulation of Light RPAS (different progress across Europe on the development of regulations and differences in the regulations being developed). Furthermore, all the main regulatory and standardization "**gaps" identified** in D1.1 and summarized in sec. 2 for **Light RPAS regulation require a "harmonized" European effort** to fill them and create a truly competitive European market of (Light) RPAS.

Nevertheless, although there is, as mentioned before, a significant "top-down" effort stemming from the EC to encourage a harmonized approach for Light RPAS regulation (which is resulting in the "regulatory activities" part of the ERSG roadmap, which also address Light RPAS, as described in ULTRA D1.1 [ref.

[1] This ULTRA project, funded by the EC, is part of the support provided by the EC to encourage the progress on RPAS.

R.5]), the **actual "quick win" on Light RPAS regulation are the national regulatory and standardization activities** which are already **resulting in regulations for Light RPAS** being implemented at national (Member State) level. These national efforts can be viewed as a "bottom up" approach if it is considered that there is already a Member States interest in harmonizing at European level the national regulatory activities, as proved by the existence of organizations like JARUS (for regulators) or EUROCAE WG93 (for industry, including also regulators/authorities).

This **ULTRA project**, as a European (EC funded) activity, is **expected to contribute from the "top-down" approach with recommendation for harmonizing the regulatory efforts at European level**, but it must be highlighted that since regulations are already being implemented in some European countries (see D1.1 [ref. R.5]) the ULTRA recommendations will take into account the existing regulations to formulate recommendations for "quick wins" and mostly oriented to European Member States with a lower level of progress in regulating Light RPAS, in order to pave the way for the desired harmonization.

ULTRA recommendations are grouped as follows:

- ***Recommendations for the regulation of light RPAS enabling immediate and short term operations ("quick win")***. These recommendations address regulatory and standardization issues ("gaps") that could be solved (at least partially) to enable Light RPAS operations within a short timeframe, in particular those **operations related to the most promising "use cases" in the short-term** (e.g. within the next 5 years), as identified in ULTRA D4.1 [ref.].
- ***Recommendations for the complete Regulation of Light RPAS ("Longer Term")***. These recommendations address regulatory and standardization issues ("gaps") for which there must be a complete set of regulations and standards to enable Light RPAS operations beyond the short-term limitations (e.g. VLOS, …), and that can be expected to be in place in a longer time frame (e.g. 10-15 years from now).

These recommendations address mainly aviation authorities / regulators but some of them are intended for industry (Light RPAS manufacturers and standardization organizations) and Light RPAS operators.

As a general guiding principle for aviation authorities / regulators, ULTRA provides the following first recommendation:

ULTRA-REC-REG-01: *The **regulation of Light RPAS** must be done in accordance with the following principles:*

- ***Simplicity** and **clarity**, to be easily understood and avoid misinterpretations.*
- ***Proportionate** to the characteristics of RPAS and operational scenarios.*
- ***Flexibility** to easily be adapted to the regulatory needs of an expected fast evolution of the Light RPAS sector.*

It must be highlighted that in order to address regulatory and standardization gaps RG-1 ("harmonization in regulations and standards at European level"), RG-2 ("*harmonization in regulations and standards at international level*") and RG-3 ("*civil-military harmonization*") an overall recommendation by ULTRA to European aviation authorities / regulators, manufacturers and operators is:

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ULTRA-REC-REG-02: ***Contribute to European (and global) "harmonization" of Light RPAS*** *regulation and standardization by* ***actively participating*** *in European (and international)* ***regulatory & standardization organizations and forums*** *(e.g. EC ERSG, JARUS, EUROCAE, EDA, NATO, ASD,…) and* ***implementing at national level the consensus / most accepted ideas and proposals****.*

But since **Light RPAS are under the remit of national aviation authorities** (as in Europe Light RPAS are excluded from the EASA remit by the Basic Regulation [ref. R.20]) it is very important for the Light RPAS business that **national regulations allow the operation of these systems in the shortest timeframe possible**. Thus, ULTRA recommendation for European aviation authorities / regulators, manufacturers and operators is:

ULTRA-REC-REG-03: *National stakeholders of the Light RPAS business, in particular* ***aviation authorities / regulators, manufacturers and operators, must cooperate closely and efficiently*** *with the goal of having national regulations enabling Light RPAS operations at national (local) level in the shortest timeframe possible. By following recommendation ULTRA-REC-REG-02, the* ***participation of these stakeholders in European (and international) regulatory & standardization organizations and forums dealing with Light RPAS*** *will facilitate the incorporation of the consensually agreed or most accepted ideas and proposals, thus* ***accelerating the generation of the national regulatory*** *and standardization material and* ***contributing to the European and global "harmonization".***

Another important "gap" affecting both the short and long-term operations of Light RPAS is the need for **aviation authorities to be familiarized with the (Light) RPAS peculiarities and have enough data** on those aspects affecting the safety of operations (see sec 2: RG-5 – "*Safety-related data and limited familiarization of authorities (and other stakeholders) with RPAS*"). Thus, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-04: ***Establish "pilot" projects*** *and associated* ***test ranges*** *(see Note #1 below) to* ***familiarize*** *with the specificities of (Light) RPAS and* ***gather data*** *relevant for the safety of operations (including incident & accident records). It must be highlighted also the importance of* ***sharing among aviation authorities the accumulated experience and safety records****.*

*NOTE 1: **"Test Ranges"** might be not only dedicated facilities for RPAS testing but places proposed by the RPAS operator and approved by the relevant CAA to perform (under the oversight of the CAA) "real" operations for applications like those "use cases" identified in ULTRA WP4.*

*NOTE 2: The existence of **European R&D projects and initiatives involving RPAS demonstrations** is a good opportunity for Aviation Authorities / Regulators to get involved and gain familiarization and information.*

*NOTE 3: Data gathering (in particular, incident & accident records) is also very relevant for insurance organizations to provide adequate and affordable **insurance policies** for Light RPAS operations (See ULTRA WP3)*

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3.2. Recommendations for the Regulation of Light RPAS enabling Immediate and Short Term Operations ("Quick Win")

3.2.1. Classification scheme

In order to address the regulatory and standardization gap "RG-4" (*globally agreed classification scheme for RPAS*) the following aspects for **Light RPAS classification** will be considered for **immediate and short term operations**:

- Aircraft categories
- RPA mass threshold(s)

A more elaborated classification scheme and better adapted to (Light) RPAS might be available in the longer-term (see sec. 3.3.1)

3.2.1.1. Aircraft categories

The aircraft categories understood as those stemming from the classification of aircraft according to specified basic characteristics are important to be considered from the initial regulations applicable to Light RPAS, as their wide variation in configurations also affect to their performance and therefore to the safety of their operation. As discussed, in ULTRA D1.1 [ref. R.5], the basic categories for RPAS are not to differ from those established for manned aviation.

As an example of current regulation considering a basic distinction in Light RPAS categories is the French Decree DEVA1206042A [ref. R.41], which distinguishes between captive and not captive RPA. A deeper distinction could be established by recognizing the following categories:

- Lighter than air (LTA) aircraft (aerostats):
  - Captive balloons
  - Non-captive balloons and airships
- Aerodynes:
  - Airplanes
  - Rotorcrafts:
    - Conventional: helicopters and gyroplanes
    - Multi (>2) rotors (e.g. quadrocopters, …)
  - Others (e.g. ornithopters)

This more detailed categorization might be more necessary to establish **safety requirements for Light RPAS subject to airworthiness certification**, since for such certification specific airworthiness codes for each (broad) category (e.g. balloons, airplanes, rotorcrafts, …) will be required (as it is the case in manned aviation). Also for other safety aspects a more detailed categorization might be necessary, in particular for **flight crew licensing and training**.

Thus, ULTRA recommendation for European aviation authorities / regulators is:

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ULTRA-REC-REG-05: *For immediate and short-term operations consider at least a **broad categorization of Light RPAS** (e.g. captive / non-captive aerostats, aerodynes) to take into account the main characteristics of their performance that might affect the safety of operations, as well as **mass thresholds** for the purpose of airworthiness certification.*

3.2.1.2. RPA mass threshold(s)

As discussed in ULTRA D1.1 [ref. R.5], because of the importance of the aircraft mass categorization in current (manned) aviation regulatory frameworks, **existing regulations and regulatory guidance** established by aviation authorities for RPAS **have also considered the RPA mass for categorization**, even though a number of issues affecting RPAS are not directly related to the mass categorization (those issues can be addressed regardless of RPA mass category), and other categorization criteria might be actually more relevant for categorization than the RPA mass.

In ULTRA D1.1 [ref. R.5], a mass break down grouping for RPAS by a number of European CAAs and other NAAs/Organizations was provided.

In addition to the 150 Kg threshold established by the Basic Regulation (Reg. 216/2008), the **most relevant mass threshold is that delimiting the requirement of certifying the airworthiness** of the Light RPAS (see sec. 3.2.2.1 on Initial Airworthiness). In some regulations mass thresholds are also used to define groups for the purpose of flight crew licensing and training, in combination with other aspects like operation range (e.g. VLOS / BVLOS) (see sec. 3.2.3 on Flight Crew Licensing and Training)

3.2.2. Airworthiness

3.2.2.1. Initial Airworthiness

To address "gaps" related to airworthiness (see sec. 2: RG-6 to RG-10) for the immediate and short-term timeframe, first, as indicated in 3.2.1.2, a **mass threshold** should be established below which Light RPAS are **exempted from airworthiness certification**, thus facilitating the quick start ("quick win") of operations of such RPAS. However, it must be highlighted that, as established in most of currently existing national regulatory material, the exemption from airworthiness certification **implies operational limitations** (e.g. VLOS operations in the shortest timeframe)

Although not all European countries regulating Light RPAS are basing the exemption on the RPA mass (some are considering, for example, the RPA kinetic energy, in combination with abovementioned operational limitation), the majority of existing or under development regulations are establishing a mass threshold for that delimitation. As described in ULTRA D1.1 [ref. R.5], mass thresholds to exempt a Light RPAS from airworthiness certifications **stem from the experience with aircraft models**, whose **operations within specific limits** are usually **exempted from the relevant CAA approval below a certain mass** of the model. ULTRA D1.1 [ref. R.5] details the current situation of this issue in Europe and other countries, from which it is derived that the two main values considered for the mass threshold delimiting the airworthiness certification requirement are **MTOM = 20 Kg and MTOM = 25 Kg**. The main advantages of each of these two MTOM values as mass threshold for airworthiness certification are indicated in Table 3-1.

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Advantages of MTOM = 20 Kg	Advantages of MTOM = 25 Kg
• Threshold in line with **Reg. (EC) 785 / 2004 (Insurance)**, according to which model aircraft with MTOM < 20 kg are exempted to comply with this regulation.	• Allows **more Light RPAS** (those from 20 to 25 kg of MTOM) **to be exempted** from certifying its airworthiness, allowing also model aircraft up to 25 Kg to become Light RPAS • **More countries** are considering this mass threshold, including not only European countries but also USA (Small UAS → up to 55 lb ~ 25 Kg) and Canada, thus considering this mass value favours a **global harmonization**. • The use of this mass threshold is already established in a number of national **regulations / policies applicable to model aircraft** (generally, as a limit above which special authorization for operation is required from the relevant CAA)

Table 3-1: Main advantages of MTOM = 20 Kg and MTOM = 25 Kg as mass threshold for airworthiness certification

Thus, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-06: *At least for immediate and short-term operations of Light RPAS consider **exempted from airworthiness certification** Light RPAS with a **RPA maximum take off mass (MTOM) up to 25 Kg** in conjunction with **operational limitations**.*

However, the fact that a Light RPAS is not subject to airworthiness certification does not prevent the relevant aviation authority from establishing a number of **requirements on design features ensuring safety** (airworthiness considerations). Thus, ULTRA recommendation for European aviation authorities / regulators is:

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ULTRA-REC-REG-07: *For Light RPAS exempted from airworthiness certification consider **requirements on design features that can significantly improve the safety of operations** (such as those indicated in ULTRA D1.1). For example, the following requirements among others might be considered where applicable:*

- *A safe and reliable flight termination system (FTS) or strategy, which must work in case the RPA exits the allowed airspace volume for the operations.*
- *Remote pilot always able to override the Guidance-Navigation-Control (GNC) system in case of an emergency such that recovering from it requires remote pilot intervention.*
- *In case of loss of communications, reliable and predictable method to recover the RPA.*
- *Robust software design (including RPS operating system), with tested flight modes (including transition between modes).*
- *"Health monitoring" features like "self-test" or BIT (Built-In Test) for the most critical functions.*
- *RPA equipped with a system enabling (density) altitude computation.*
- *RPA equipped with a solution implemented to ensure that it will not exceed the maximum allowed altitude, and it will work also in the event of loss of link.*
- *RPA structure designed to minimize damage to third parties and people operating the RPA (e.g. materials frangibility / shocks absorbent, no sharp shapes, moving parts, etc.)*
- *Protected batteries and/or battery chemistry to minimize risk of flammability during manipulation or RPA crash.*
- *Paint scheme and lights to increase "visibility" and "detectability", as well as situational awareness (remote pilot aware of RPA attitude)*
- *The data link system can be set up to use allowed frequencies and power emission iaw. the applicable telecommunication regulation.*
- *"Friendly" and intuitive (remote pilot oriented) Human-Machine Interface (HMI) design.*
- *Properly designed (HMI) alerts & warnings for the most critical aspects (e.g. aircraft performance limitations, data link signal, voltages, GPS signal, etc)*
- *Remote Pilot Station (RPS) allowing the use of the required maps / navigation charts.*
- *RPAS design compatible with the operating conditions: temperature, density altitude, wind, rain, icing conditions, humidity, sand dust, fungus, salt spray, electromagnetic environment (EMI), …*
- *Secure RPAS design (or operational restrictions) against interference (unintentional or intentional) of data links and GNSS (e.g. GPS) receiver signals.*
- *Payload used for the intended operation is securely attached to the RPA and does not interfere with onboard equipment (e.g. GNC)*

*The **organization undertaking the design and production** of the Light RPAS must be considered adequate for these tasks by the relevant aviation authority, as indicated in ULTRA-REC-REG-09.*

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For those **Light RPAS not exempted from airworthiness certification**, at least a **policy / guidance material must be developed** to facilitate Light RPAS manufacturers to start an airworthiness certification process (for a type certificate, flight permit / experimental certificate, …) knowing in advance the procedure and main requirements which allow manufacturers to assess adequately the feasibility of the intended process and conduct the corresponding planning.

However, the timeframe that includes issuing policy / guidance material by a national aviation authority and the completion of an airworthiness certification process by the earliest applicant following that material can be expected beyond what can be considered as "short timeframe". Therefore, **airworthiness certification is to be considered in the "longer term"** (see sec. 3.3), even though some European Member States may issue some policy / guidance material at a shorter stage.

With regard to **standards related to initial airworthiness** (design and production), as described in ULTRA D1.1 [ref. R.5], a number of them applicable to Light RPAS have been already produced or are under development by relevant standardization groups. For example, ASTM (Technical Committee F-38) has already available and under development a number of standards applicable to "Small UAS" (RPA weighing up to 55 lb ~ 25 Kg), e.g.:

- *Specification for Design and Construction of small UAS (a standard for each group, from I to III)*
- *Specification for Small UAS Command and Command and Control Links*
- *Practice for Production Acceptance of small UAS (multi-copy production)*
- *Specification for Testing of a small UAS*
- *Specification for batteries used for small UAS*
- *Specification for Position, Altitude and Airspeed reporting of small UAS*
- *Specification for Quality Assurance of a small UAS*

These and other standards already available can be used by manufacturers intending to offer Light RPAS for short-term operations, in particular for Light RPAS exempted from airworthiness certification (since those not exempted are not expected for the short term as abovementioned). The use of these standards can facilitate a wider acceptance by authorities and potential operators, as well as contribute to foster a "harmonized" standardization, being the latter a contributing factor to "close the gap" RG-6 (""*Harmonized approach" for Initial Airworthiness of Light RPAS*"). Thus, ULTRA recommendation for European manufacturers is:

ULTRA-REC-REG-08: ***Manufacturers*** *intending to offer Light RPAS for short-term operations and not subject to airworthiness certification should* ***consider using existing design and production related standards*** *(such as those indicated in ULTRA D1.1) in order to seek wider acceptance by aviation authorities and operators / end users, as well as foster a "harmonized" standardization.*

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3.2.2.2. Approval of Design and Production Organizations

As indicated in ULTRA D1.1 [ref. R.5], requirements for DOA and POA (included in Part 21 [ref. R.21], subparts K and G, respectively) can be considered excessively demanding for most organizations designing and producing Light RPAS, in particular systems exempted from airworthiness certification (see ULTRA-REC-REG-06). As stated in ref. R.101, **Small and Medium Enterprises (SMEs)**[2] **represent the majority** ("more than 80%") **of the companies involved in the development, manufacturing** and exploitation of Light RPAS. For most of these SMEs **complying with DOA/POA requirements would be beyond their resources**.

However, as described in ULTRA D1.1 [ref. R.5], the military approach taken with the STANAG 4703 [ref. R.63] or STANAG 4738 [ref. R.64] might be more affordable and also applicable to a "civil environment", as their requirements derive from the Essential Requirements stated in the EC Basic Regulation [ref. R.20], which basically demand to organizations undertaking design and manufacturing Light RPAS to provide to the relevant aviation authority with evidences of:

- Implementation of a **Safety Management System (SMS)**, which includes the elaboration of a **Safety Management Plan** (SMP)
- Certification of the **organization quality system** in accordance with AS/EN 9100 or an equivalent standard (acceptable to the relevant aviation authority).

For short-term operations, however, most SMEs producing market-ready Light RPAS that could be exempted from airworthiness certification (see sec. 3.2.2.1), do not comply with abovementioned requirements included in STANAGs 4703 and 4738. Nevertheless, a **number of SMEs have already or are in the process of being granted with an ISO/EN 9001 certification** for their quality management system in their activity of developing and producing Light RPAS. The certification of organizations with internationally recognized standards will help to "close the gap" on "*Harmonized requirements for Light RPAS Design, Production and Maintenance Organisations*" (see RG-10 in sec. 2). A few examples of these SMEs claiming to have ISO 9001 certification are included in sec. 1.5 (see ref. R.105 to R.111). There are also examples of star-up SMEs that have received a recognition of quality at national level (e.g. ref. R.107)

Thus, considering the relevance of the organization "System Monitoring" (based on the organization quality assurance system) as a pillar of the organization "Design Assurance System" and the production system, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-09: *For **organizations undertaking the design and production** of Light RPAS exempted from airworthiness certification proportionate requirements (i.e. affordable for SMEs) might be considered, like a **certified quality management system** in accordance with recognized standards like **ISO 9001** (or at least based on a national recognition of quality that can be widely recognized).*

[2] See EU definition at http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/index_en.htm (retrieved 06/05/2013)

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3.2.2.3. Continuing Airworthiness

Likewise "initial airworthiness", at least a **policy / guidance material for continuing airworthiness** (in particular, safety aspects in RPAS maintenance) **must be developed** for Light RPAS operators to ensure that the airworthiness of the Light RPAS is maintained and the corresponding evidence can be provided to the relevant authority. Since, as mentioned before, the airworthiness certification issue is considered in the "longer term", the corresponding requirements for maintaining the airworthiness might also be considered in the "longer term". Nevertheless, some **basic requirements can be established for a short-term application**, like those already included in the existing national regulations.

Thus, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-10: *Establish **basic requirements to ensure continuing airworthiness** in short-term operations of Light RPAS. Among these requirements at least the following items should be considered:*

- ***Safety management system (SMS)** of the related organizations (operator and/or maintenance organization). If the organization undertaking the **MRO** (maintenance, repairs and overhaul) activities is the Light RPAS operator, the SMS is the corresponding to the operator (see ULTRA-REC-REG-18)*
- *The Light RPAS manufacturer must provide a **Maintenance / MRO manual**(s) which must include all the required instructions for the inspection, maintenance and repair tasks to be performed by the operator (or the corresponding contracted maintenance organization) to maintain airworthy the Light RPAS.*
- *The Light RPAS manufacturer must provide **procedure(s) / checklist(s) to check the RPAS status** before, during and after the operation (flight). These procedure(s) / checklis(s) can be part or separate from the maintenance / MRO manual(s).*
- ***Personnel** undertaking maintenance tasks must be **properly qualified according to the manufacturer criteria**, subject to the aviation authority approval, and, as far as practical, in accordance with **aviation standards**.*
- *The Light RPAS operator must ensure that at least the following **aspects are recorded** (e.g. in a "RPAS Logbook"):*
  - *Operative data for each flight, including flight duration.*
  - *All deficiencies that have been occurring after and during the flights, which must be analyzed and determine how to fix them. Repetitive deficiencies must be carefully followed.*
  - *Flight hours, operation cycles, inspections and maintenance activities performed on each element of the Light RPAS.*
- *The Light RPAS operator must **inform the manufacturer on the deficiencies** found on the Light RPAS, in particular the safety-relevant and repetitive ones. The Light RPAS manufacturer must **keep record on these deficiencies and take action** to solve them. The information on these deficiencies recorded by operators and manufacturers are subject to inspection by the relevant aviation authority or qualified entity.*

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Likewise "initial airworthiness", there are a few (industry) standards applicable to continuing airworthiness of Light RPAS that are already available and can be used by RPAS Operators / Maintenance Organizations. For example, ASTM (Technical Committee F-38) has already available the standard for "Small UAS" (RPA weighing up to 55 lb ~ 25 Kg) *Practice for Conducting Field Maintenance of a small UAS.* The use of these standards can facilitate a wider acceptance by authorities, as well as contribute to foster a "harmonized" standardization, being the latter a contributing factor to "close the gap" RG-7 ("*Harmonized approach" for Continuing Airworthiness of Light RPAS*). Thus, ULTRA recommendation for European RPAS operators / maintenance organizations is:

ULTRA-REC-REG-11: ***RPAS operators / maintenance organizations*** *intending to operate / maintain Light RPAS for short-term operations and not subject to airworthiness certification should* ***consider using existing standards for continuing airworthiness*** *(such as those indicated in ULTRA D1.1) in order to seek wider acceptance by aviation authorities, as well as foster a "harmonized" standardization.*

3.2.3. Flight Crew Licensing and Training

Likewise manned aviation, where aircraft classes and type ratings are defined, in order to establish the requirements for the licensing and training of a remote pilot / flight crew a classification of RPAS must be established.

As described in ULTRA D1.1 [ref. R.5], in the case of Light RPAS the regulatory material being produced at national level in Europe is starting to establish requirements for the licensing and training of a remote pilot / flight crew taking into consideration a basic categorization, which in most cases is based on the distinction between VLOS/BLOS operations[3] and, in some cases, also on RPA mass interval. However, the use of latter subject to debate in different RPAS forums, and therefore might not be advisable to propose the RPA mass for the purpose of "harmonizing" Light RPAS categorization for remote pilot / flight crew licensing and training (in order to contribute to "close the gap": RG-11 – *"Harmonized" requirements for Flight Crew Licensing & Training).*

Thus, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-12: *In order to enable short-term operations of Light RPAS, consider for* ***Flight Crew Licensing & Training*** *a* ***categorization based on the distinction between VLOS/BVLOS*** *operations.*

NOTE: according to EUROCONTROL taxonomy, BVLOS operations are below VLL (very low level), but approval of some operations out of VLOS and above VLL might be granted in some specific cases in the short-term.

Experience has proved that, since current unmanned aircraft are actually remotely piloted ones, that is, with a remote pilot / flight crew in charge of piloting the aircraft (with different levels of automation / pilot intervention capability), **human (pilot) error is, like in manned aviation, a major contributor to accidents and incidents** with RPAS, and this is true for **all kind and sizes of RPAS**. Therefore, it is

[3] In some cases, like in France, specific limits for distance between RPA and pilot are considered, but these can also be grouped into VLOS and BVLOS

paramount to ensure a **proper qualification and training of remote pilots / flight crews for all remote pilots / flight crews**. As shown in ULTRA D1.1 [ref. R.5], most national regulations / regulatory material issued or being drafted consider that **licensing is required for all categories of Light RPAS and operations**. Thus, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-13: *Consider **Flight Crew Licensing for all Light RPAS categories and operations** (defined as recommended in ULTRA-REC-REG-12)*

Regarding the requirements for Light RPAS Flight Crew Licensing, most national civil aviation authorities are considering:

- Theoretical ("ground") training on Aviation fundamentals, including in most cases the main subjects corresponding to a **Private Pilot License (PPL)**, and adding in some cases more subjects and/or a deeper focus on key areas (e.g. ATM/ATC, communications, …) for the advance training required for some operations (e.g. BVLOS)
- Light RPAS "type rating": theoretical and practical ("flight") training on the specific Light RPAS that is/are intended to be piloted by the licensed remote pilot.

Besides, some authorities (e.g. CAA in France) are also requiring the demonstration of knowledge and skills in the type of operation intended to be performed.

Thus, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-14: *Consider for **Light RPAS Flight Crew Licensing** a requirement on successfully completing:*

- *A **theoretical ("ground") training on Aviation fundamentals**, imparted by the **approved operator** (course to be indicated in the Operations Manual) or an **approved organization** (approved training organization – ATO), and that includes, at least, the following subjects (like those generally included in the syllabus for a Private Pilot License – PPL):*
  - *Aviation Regulations*
  - *Operational Procedures*
  - *Communications (including standard R/T procedures and phraseology)*
  - *Meteorology*
  - *Navigation (including charts interpretation)*
  - *Principles of Flight*
  - *Flight Performances and Planning*
  - *Aircraft General Knowledge*
  - *Main RPAS characteristics (including RPS and data links)*
  - *Human Factors and application to RPAS*

  For BVLOS operations, a more in-depth theoretical training might be required (basically, the same subjects above indicated but with a deeper extent, in particular for those related with operational

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procedures, navigation, and communications)

*In addition, for short-term operations in BVLOS, holding a **private pilot license (PPL)** (for manned aviation) might be considered. In case of requiring this license, it should not need to be kept current, since the purpose of holding it is to demonstrate the knowledge on aviation fundamentals and "good airmanship" and not to show the skills of piloting a manned aircraft.*

- *A **theoretical and practical training on the specific Light RPAS to be piloted** ("type rating") and the **intended type of operations**, imparted by the **approved operator** or an **approved organization** (approved training organization – ATO). A **declaration of level of competency** (or equivalent) must be issued by the approved operator (or the contracted ATO) after successful completion of the training course, which must include the demonstration of the required level of skills on the Light RPAS operation.*

*The **training programme must be approved by the relevant civil aviation authority**.*

A usual feature in RPAS, including Light RPAS, is the provision of the capability to plan and simulate missions. Even though in most cases for Light RPAS this feature does not allow to train on RPAS failures, it can be considered an important tool for the remote pilot / flight crew training. Interestingly, there are also commercially available simulators for training on remote control model aircraft

Thus, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-15: *With regard to the use of **"flight simulator training devices" (FSTDs)** for the **practical training of remote pilot / flight crew** consider as requirements:*

- *The **organization undertaking the practical training** of remote pilot / flight crew must **include the use of FSTD adequate** to Light RPAS for which training is provided.*
- *The **Light RPAS manufacturer must provide**, or at least **identify**, the **recommended FSTD** for the qualification ("type rating") of remote pilots / flight crew on each Light RPAS type being supplied by the manufacturer.*

Regarding the approval of organizations undertaking the training of remote pilots / flight crews (ATOs), ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-16: *For the **approval of organizations undertaking the complete training** (including practical – flight– training with Light RPAS) of remote pilots / flight crews (ATOs) for Light RPAS consider included **requirements for operators** (see ULTRA-REC-REG-17), since in fact the training organization must be approved as operator to perform the training flights.*

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3.2.4. Operations and Operators

3.2.4.1. Operations

According to the latest definitions on RPAS operations by EUROCONTROL, described in the working document of the ERSG Roadmap, presented in ref. R.102 and included in the latest version of ULTRA D1.1, the following types of operations are considered for RPAS:

- Very Low Level (VLL) Operations
  - Visual Line of Sight (VLOS) Operations
  - Extended VLOS (E-VLOS) Operations
  - Beyond VLOS (B-VLOS) Operations
- IFR/VFR Radio Line of Sight (RLOS) Operations
- IFR/VFR Beyond RLOS (BRLOS) Operations

In principle, for **Light RPAS** the most suitable type of operations, and especially considering the **"short-term"**, are the **Very Low Level (VLL)** operations.

As described in ULTRA D1.1 [ref. R.5], within the VLL operations, those in **VLOS are already being approved** by a number of national civil aviation authorities, although these VLOS operations are in principle only suitable for the smallest Light RPAS as the limits for the distance between RPA and remote pilot **commonly established for VLOS are usually 500 m horizontal and 400 ft vertical**, so even for a number of Light RPAS these limits are not practical unless the RPAS size range is similar to that of aircraft models, being actually some regulatory material on these aircraft models the source for the abovementioned limits on distances (e.g. CAP 658 [ref. R.36]). Such limits are considered **sufficient to ensure that remote pilots can respond to and avoid other airspace users and obstacles**. Nevertheless, some CAAs specify (e.g. ref. R.35) that larger distance limits can be considered if it can be proved that the RPA is visible by the remote pilot at those distances.

However, there are applications ("use cases", see ULTRA D4.1) for which flying the RPA beyond VLOS would be required. Some current regulations / policies on Light RPAS (e.g. ref. R.35, ref. R.41) leave the "door open" to these **operations beyond VLOS** as long as **sufficient mitigating factors** are demonstrated to the relevant CAA, usually as part of a **"safety case"** to be performed by the interested operator. Among those mitigating factors are flying over non-populated areas and using RPA with low mass / kinetic energy (e.g. in ref. R.41, a mass limit of 2 Kg is established for operations BVLOS).

As indicated in ULTRA D1.1 [ref. R.5], the use of "RPA Observers" to extend the range limitations and permit the so called **"Extended VLOS" (E-VLOS)** is being already assessed by a number of national CAAs. For example, the CAA UK includes in the latest edition of the CAP 722 [ref. R.35] a number of requirements for the operator intending to perform this kind of operations, which might be taken into consideration by other CAAs as well.

Regarding visibility conditions, most of current regulations on Light RPAS only consider daylight and VMC conditions to perform operations. However, **there are applications for which night operations and all-weather conditions might be required**, like emergency services support (e.g. fire-fighting, search & rescue, …). Thus, CAAs might consider approving those operations with Light RPAS in a case by case basis in the short-term.

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With regard to the **minimum distance values of the operating RPA respect to people and infrastructures**, the values usually required for aircraft models (e.g. ref. R.36) can be also required for the segment of small Light RPAS (those not requiring airworthiness certification as they can be assimilated by their performances to aircraft models → see sec. 3.2.2.1), and such values are actually being established for Light RPAS in a number of national regulations. However, as indicated in ULTRA D1.1 [ref. R.5], with regard to the **minimum distance to infrastructures**, it has to be taken into account the fact that an infrastructure might be the subject of the mission performed by the RPAS (e.g. infrastructure inspection), and therefore the **distance values might need to be revised** to enable those kind of missions at the same time that are performed in an acceptable (safe) manner to the relevant aviation authority (current values might be conservative considering that are applied to hobbyist flying model aircraft)

Considering all the above, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-17: *In order to enable short-term operations of Light RPAS consider:*

- *Allowing **routine daylight VMC Visual Line of Sight (VLOS) operations** based on:*
  - *The **assessment on the Light RPAS design**. For those Light RPAS exempted from airworthiness certification (see ULTRA-REC-REG-06) consider recommendations indicated in ULTRA-REC-REG-07 regarding design features to ensure the safety of operations. For operations with Light RPAS not exempted from airworthiness certification the operator must hold a valid certificate of airworthiness or equivalent document issued by the relevant aviation authority (see ULTRA-REC-REG-22).*
  - *The **qualification of the remote pilot / flight crew and currency** of their licensing and training, considering recommendations indicated in ULTRA-REC-REG-14.*
  - *The **approval of the operator** (organization) based on requirements like those indicated in ULTRA-REC-REG-18.*
  - *The **approval by the relevant national authority of the radio frequencies** to be used in the operation of the Light RPAS, in accordance with the **available spectrum** (not restricted to other uses / users) and considering the **characteristics of the Light RPAS communications (C3)** system and the operating environment.*
  - *The **definition of the limits for the distance between the RPA and the remote pilot (PIC)**, which in a general case can be taken as those being applied already by a number of CAAs to allow VLOS operations: 500 m horizontally and 400 ft vertically. However, there are cases (e.g. relatively large fixed wing Light RPA) for which these values are too restrictive and, at the same time the RPA can be visible to the remote pilot (PIC) at a larger distance. Therefore, it is recommended that an **assessment can be used in cases requiring it to define the most adequate distance limits**.*
  - *The **definition of the minimum distances to people** (in particular, not involved in the operation) **and infrastructures**. Reasonable minimum distance values must be established to **allow operations requiring to fly closer to infrastructures** (e.g. infrastructure inspection) than in a general case (as usually these distance values have been established for model aircraft flights)*
  - *A **"risk assessment and mitigation plan"** to be approved by the relevant aviation authority for the operations to be performed See requirements on the (Light) RPAS operator (ULTRA-*

REC-REG-18)

- *Allowing **night VLOS operations** on a "case by case basis" (routine operations in the "longer term") based on:*
  - *The abovementioned requirements for "daylight" VLOS.*
  - *A **"safety case" including a "risk assessment and mitigation plan"** to be approved by the relevant aviation authority for the particular missions requiring flights in night conditions (e.g. support to emergency services like fire-fighting, search & rescue, …)*
  - *RPA equipage including **anti-collision lights and navigation lights** or, alternatively, lighting that illuminates the aircraft's sides so that its attitude and flight direction can be seen clearly.*
  - *The **remote pilot / flight crew qualification for night operations** (e.g. successfully pass "night VFR" theory and night operations training with an RPAS like the intended for the night operation). If not included in the FCL requirements for daylight operations, a **medical examination including "night vision" and "colour" tests should be required**.*

  NOTE: Night VLOS operations need to be defined (e.g. distance of the RPA to the remote pilot might be different from that in daylight VLOS operations, visibility requirements, etc.)

- *Allowing **E-VLOS operations** on a "case by case basis" (routine operations in the "longer term") based on:*
  - *The abovementioned requirements for "daylight" VLOS.*
  - *A **"safety case" including a "risk assessment and mitigation plan"** to be approved by the relevant aviation authority for the particular missions requiring flights in "extended VLOS" (E-VLOS) conditions. Among factors to be taken into account are:*
    - ✓ *procedures for the use of observer(s) and to ensure the adequate communication between observer(s) and remote pilot(s) (e.g. use of suitable radio equipment) ;*
    - ✓ *procedures to ensure avoidance of collisions;*
    - ✓ *aircraft size, colour and markings, and any aid to observation;*
    - ✓ *meteorological conditions and visibility;*
    - ✓ *operating range limits.*

    See requirements on the (Light) RPAS operator (ULTRA-REC-REG-18)

- *Allowing **B-VLOS operations** on a "case by case basis" (routine operations in the "longer term") based on:*
  - *The abovementioned requirements for "daylight" VLOS.*
  - *A RPA that can be considered **"inherently harmless"** due to its mass (e.g. < 2 Kg), kinetic energy (e.g. < 75 J) and construction characteristics (e.g. materials shock absorbance and frangibility, shape, …)*
  - *A **"safety case" including a "risk assessment and mitigation plan"** to be approved by the relevant aviation authority for the particular missions requiring flights "beyond VLOS" (B-VLOS) conditions. See requirements on the (Light) RPAS operator (ULTRA-REC-REG-18)*

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- *Since a **"Detect and Avoid"** solution approved by the relevant aviation authority is not expected to be available for short-term operations, an **airspace segregation** might be required, thus **compliance with the airspace segregation procedure** will be required (e.g. NOTAM request procedure)*
- *Additionally, and in order to increase remote pilot / flight crew situational awareness, a **dedicated camera with frontal vision** might be required.*

3.2.4.2. Operators

The requirement of (Light) RPAS operators to be approved by the relevant aviation authority is paramount to ensure that a satisfactory level of safety in the operations can be achieved.

In fact, all regulations in place or being developed at national level are including requirements for the approval of operators of (Light) RPAS, and most of these regulations have a number of similar requirements to be fulfilled by operators, thus such requirements can be used as a basis for any regulation to be developed by other national aviation authority / regulator to approve operators for, at least, short-term operations.

As indicated by ICAO [ref. R.27], *due to the unique characteristics involved in* [RPAS] *operations, a new* [RPAS] *operator certificate, similar in nature and intent to the existing* [aircraft] *operator certificate* [AOC]*, is envisaged. This* [certificate] *would authorize the operator to* conduct [RPAS] *operations in accordance with the operations specifications*. However, the approval of (Light) RPAS operators with current national regulations does not necessarily have associated the issuance of an "operator certificate" (AOC-like), but it can be just an acknowledgment of receipt of all the required documentation and evidences (especially if the approval by the relevant aviation authority is based on an operator declaration of compliance)

Thus, considering the existing regulatory material described in ULTRA D1.1 [ref. R.5], ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-18: *In order to enable short-term operations of Light RPAS consider the following requirements for the **approval of (Light) RPAS operators**:*

- *The operator must implement a **safety management system (SMS)** that ensures that there is a **monitoring system** to monitor that the proposed mitigation measures for the identified risks of operations are in place and are effective. This SMS has to be described in the Operator's Manual (see below). As a reference, the CAA UK «SMS Guidance for Small Non Complex Organisations» might be used.*
- *An **Operator's / Operations Manual** or equivalent has to be developed by the operator and approved by the relevant aviation authority. As a minimum, the following aspects must be included:*
  - *General*
    - *Organization, responsibilities and nominated personnel*
    - *Operations description (area of operation and related infrastructures, operating limitations and conditions, personnel taking part of operations, ...)*

- *Safety Management System (SMS) and operations control*

o *Operating Procedures*
- *Flight planning / preparation*
- *On site procedures and Pre-flight checks*
- *Flight procedures*
- *Emergency Procedures*

NOTE: Particular RPAS procedures are included in the corresponding Flight / User Manual

o *Training Programme (in particular for remote pilots / flight crew and maintenance personnel)*

o *Maintenance policy and related personnel qualification*

NOTE: this can be included in a different document referenced in this manual

o *RPAS taking part of operations (general description, limitations, ...)*

o *Appendices (including copy of the CAA permission, ...)*

- ***Flight / User Manual*** *(or equivalent) for each of the (Light) RPAS types/models to be operated (provided by the (Light) RPAS manufacturer).*
- ***Maintenance Manual*** *(or equivalent) for each of the (Light) RPAS types/models to be operated (provided by the (Light) RPAS manufacturer).*
- ***Risk assessment and mitigation plan*** *for the operations to be performed (see ULTRA-REC-REG-17). The relevant aviation* ***authority should provide guidelines*** *on how to carry out this assessment and plan.*
- ***Test flights****, with the corresponding tests definition approved by the relevant aviation authority, and the corresponding* ***test flight reports****, to demonstrate the safety of operations.*
- *(Liability)* ***Insurance*** *covering the intended operations.*
- ***Declaration of operator compliance*** *where the operator declares that:*
  - *The operator has full responsibility on its operations.*
  - *The operations can be performed safely within the approved conditions and limitations*
  - *The operator is committed to perform the operations safely within the approved conditions and limitations and be monitored by the implemented safety management system.*
  - *The remote pilots / flight crew have been duly qualified and trained for the (Light) RPAS to be operated by them and in accordance with the training programme included in the Operator's / Operations Manual.*
  - *The maintenance activities are performed iaw. the (Light) RPAS instructions and by qualified personnel (i.e. duly trained by the operator and/or RPAS manufacturer)*
  - *The operations are covered by the corresponding insurance.*

Once the operator fulfils all the requirements the relevant aviation authority should provide the operator with a ***"RPAS operator certificate"*** *or at least an acknowledgment that all the required documentation and evidences have been presented (and consequently the operator can be considered approved)*

As indicated in ULTRA D1.1 [ref. R.5], a number of Light RPAS operators have been already approved by some national aviation authorities to operate for civil and commercial applications (E.g. more than 200 operators approved in France, more than 180 in UK, and more than 120 in Sweden). Some of these authorities are **publishing on their website the list of approved operators** (e.g. ref. R.98], [R.97] and

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R.99]), which can be very beneficial for the end users, and ultimately to the unmanned aviation business, since it **helps those end users to select operators that have passed the minimum requirements** deemed necessary by the relevant aviation authority to ensure the safety of operations with Light RPAS.

Thus, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-19: *Consider **publishing on the public part** of the relevant aviation authority's **website** the **list of approved (Light) RPAS operators**, including at least: operator name, address, approval / operator certificate ID , type of activity/operation, RPAS category used.*

3.3. Recommendations for the complete Regulation of Light RPAS ("Longer Term")

3.3.1. Classification scheme

For a "longer term" timeframe a classification other than, or additional to, the mass criteria might be considered to better solve the currently existing "gap" (sec. 2: *RG-4 – globally agreed classification scheme for RPAS*).

As described in ULTRA D1.1 [ref. R.5], multiple other metrics have been proposed to classify RPAS (e.g. RPAS related characteristics – kinetic energy, endurance also versus other parameters, level of autonomy, launch and recovery capabilities – , operating environment, mission type, …). As indicated in D1.1, among these metrics, the **"level of autonomy"** might play an important role in the classification of RPAS, as it has a direct impact on the **"level of complexity" of the RPAS**, and consequently it is expected to be a **relevant aspect for regulatory requirements**, e.g. for airworthiness certification (in particular for the apportionment of probability requirements regarding safety objectives, see sec. 3.3.2.1), organizations approval (in particular design and production organizations approval, see sec. 3.3.2.2), as well as flight crew licensing & training and operations. Although the levels of complexity of (Light) RPAS have not yet been standardized, with regard to the "level of autonomy" different models and definitions have been produced. From examples of such models being depicted in ULTRA D1.1 [ref. R.5], a "basic" classification could be established considering three groups of Levels of Autonomy (LoA) as proposed in Figure 3-3.

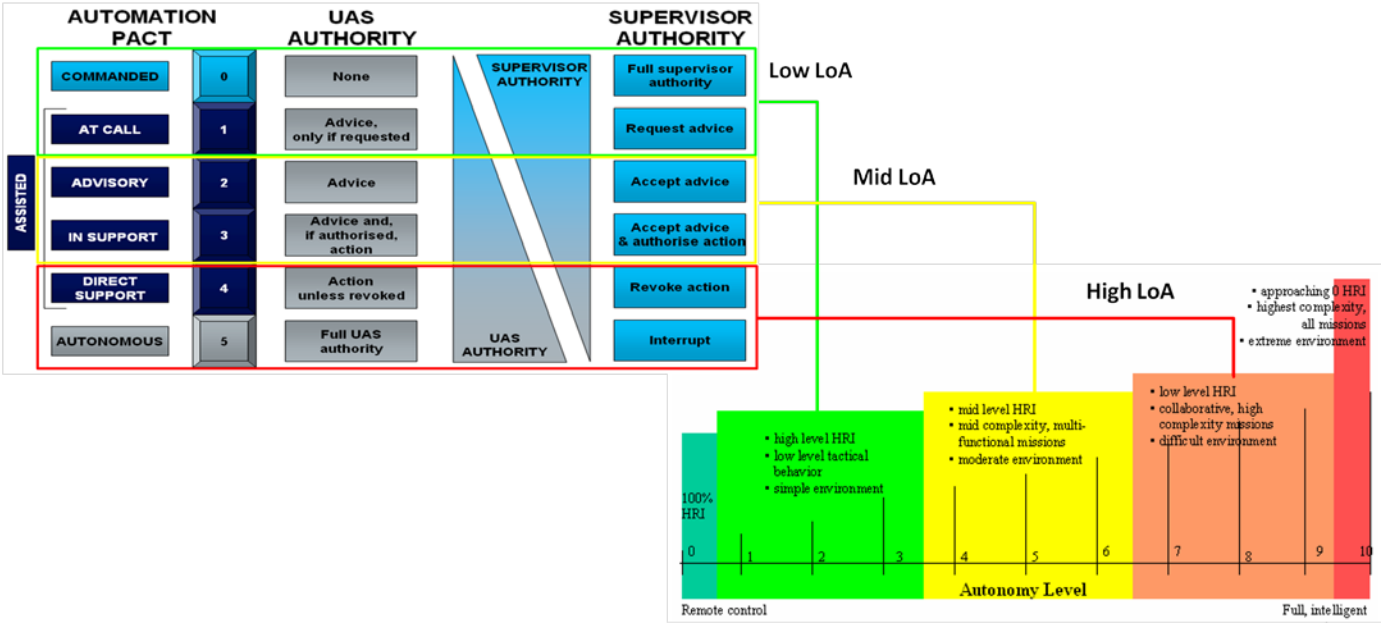

Figure 3-3: Example of possible classification of RPAS according to levels of autonomy (source: elaboration based on ASTRAEA (left) and ALFUS (right) models)

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Considering an example like that depicted in Figure 3-3 and other aspects (e.g. critical systems complexity: GNC system including data links system, other equipment with complex electronic hardware and software – CEHS[4], etc.), (Light) **RPAS could be classified**, for example, as: **"low", "medium / moderate" and "high" complexity (Light) RPAS**, allowing the establishment of the corresponding set of requirements for each of these classes of (Light) RPAS.

Furthermore, the concept of **"level of complexity"** can be also **extended to operations** (i.e.. mission complexity) and **operations environments / scenarios**.

Thus, ULTRA recommendation for European aviation authorities / regulators and industry standardization groups is:

ULTRA-REC-REG-20: *Establish a **classification scheme** that includes **levels of complexity** (e.g. "low", "medium/moderate" and "high") for:*

- *The **(Light) RPAS**, based, among other aspects, on the **levels of autonomy** and the level of **complexity of safety critical systems** (e.g. GNC system including data links system, and any other safety relevant equipment with complex design – e.g. including CEHS).*
- *The **operations**, that is for the **characteristics of the mission** to be performed by the (Light) RPAS (e.g. a mission involving the cooperation of several Light RPAS might be a complex one)*
- *The **operational environment / scenario** (e.g. a daylight VLOS operation in a non-populated area might be considered a low complexity scenario, whereas a BVLOS in night conditions and urban environment might be considered a high complexity scenario)*

*A **global agreement** (ULTRA-REC-REG-02) upon such an scheme is fundamental for the global acceptance of the derived regulatory and standardization requirements.*

Nevertheless, **until metrics are agreed, the criteria indicated in sec. 3.2.1** (aircraft categories and RPA mass threshold(s)) **is expected to keep current**. If new metrics are to be considered for the classification of Light RPAS, the experience accumulated with the (short-term) Light RPAS operations (sec. 3.2) will play an important role. Thus, ULTRA recommendation ULTRA-REC-REG-04 is paramount for aviation authorities to get that experience, and it is also important the following ULTRA recommendation for European aviation authorities / regulators:

ULTRA-REC-REG-21: *Built upon the experience accumulated with Light RPAS operations (see ULTRA-REC-REG-04), consider **sharing that experience with other aviation authorities** (e.g. via JARUS or other forums) with the purpose of determining, if deemed appropriate, a **better and harmonized classification scheme for Light RPAS** that can be used to enhance the "short-term" developed regulations.*

[4] For the definition of CEHS, references like EASA Certification Memorandum on Software & Complex Electronic Hardware [ref. R.33] and FAA Order on "Simple and Complex Electronic Hardware Approval Guidance" [ref. R.53] as well as the referenced standards (e.g. RTCA / EUROCAE) can be consulted.

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3.3.2. Airworthiness

3.3.2.1. Initial Airworthiness

As described in ULTRA D1.1 [ref. R.5], for the airworthiness certification of Light RPAS subject to this process, the preference among CAAs is for a "classic approach" based on a **"Part 21** [ref. R.21]-**like" approach** (instead of the "Safety Target" approach) with a **certification basis derived from "airworthiness codes"**.

Therefore, there should be eventually "airworthiness codes" applicable to different (Light) RPAS categories. In fact, within JARUS (ref. R.95) a couple of codes are being drafted, one of which is applicable to light rotorcraft RPAS [ref. R.58] and the draft is already available (downloadable from ref. R.95). But it will take time until all required codes are developed and approved at national level (e.g. transposed from JARUS to the national regulatory framework), and in the meantime the approach that is being followed by a number of CAAs is based on:

- **Using applicable "airworthiness codes" from the military side**, like the STANAGs described in ULTRA D1.1 [ref. R.5] (in particular: STANAG 4703 [ref. R.63] and 4738 [ref. R.64]).
- **Deriving or tailoring the corresponding manned aviation airworthiness requirements** ("airworthiness codes"), as indicated in the EASA policy [ref. R.26].

Thus, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-22: ***Develop policy / guidance material*** *to facilitate Light RPAS manufacturers to conduct an* ***airworthiness certification process*** *in a more structured and standard manner (not in a "case by case" basis), allowing the RPAS certification (even if "restricted") in a reasonable timeframe (that can be assessed by the manufacturer). This policy / guidance material must include at least:*

- ***General airworthiness certification procedure****. Indicate to what extent "Part 21" (Reg. EU No 748/2012) or national equivalent regulation is applicable and what alternative approach (if any) can be followed and under what conditions.*
- *In the* ***absence of specific "airworthiness codes"*** *for the different categories of Light RPAS, include:*
  - *The* ***policy on the military "airworthiness codes"*** *(e.g. STANAGs) that might be accepted to derive the Certification Basis (including the corresponding Means of Compliance).*
  - *A* ***methodology to derive the airworthiness requirements*** *(certification basis) and corresponding* ***means of compliance*** *in case* ***manned aviation "airworthiness codes"*** *have to be selected and tailored because existing military "airworthiness codes" are not deemed suitable. If EASA Policy (E.Y01301) is applicable, it should be explicitly stated.*
- ***Certificates / certification documents*** *that can be issued by the relevant aviation authority (e.g. (restricted) type certificate for the type design, (restricted) certificate of airworthiness / permit to fly for the individual RPA / RPAS, …)*
- *Policy to* ***approve design and production organizations****. See ULTRA-REC-REG-25.*

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With regard to **safety objectives**, as indicated in ULTRA D1.1 [ref. R.5], it is paramount to agree upon a **classification of failure conditions** and the **probability terms for each category of failure conditions**. This agreement should lead to close the gap on with **"harmonized" safety objectives applicable to Light RPAS in their different categories**. Based on the issues and approaches described in D1.1 [ref. R.5], ULTRA recommendation for European aviation authorities / regulators as well as (industry) standardization organizations is:

ULTRA-REC-REG-23: *In order to establish the **safety assessment approach** ("1309") and **safety objectives** applicable to Light RPAS*:

- ***Consensus between aviation authorities / regulators and industry** must be reached at **European and global level** as well at **civil-military level** (see ULTRA-REC-REG-02)*
- *For **short-term applications** and early adoption of airworthiness codes (see ULTRA-REC-REG-22) consider the **"traditional" approach** of separating "classical" airworthiness issues and "classical" operational issues. For the **longer term** consider in the airworthiness certification the **operational environment and operations characteristics that might affect airworthiness**.*
- *With regard to the **definitions of failure conditions severity and classification**:*
  - *For **short-term** applications (until the abovementioned consensus is reached) consider those **definitions contained in the "airworthiness code(s)"** used for the certification basis.*
  - *For the **longer-term**, these definitions should be established taking into consideration the **end effect** (harm, increased workload, …) **of Light RPAS operations on third parties** (on ground and in the air) **and remote pilot / flight crew**.*
- ***Safety objectives** must be **proportionate** to the actual damage that each (Light) RPAS category can cause :*
  - *For **short-term** applications (until the abovementioned consensus is reached) consider the safety objectives and corresponding safety requirements included in the **"airworthiness code(s)"** used for the certification basis.*
  - *For the **longer-term**, safety objectives and requirements should be established considering:*
    - *An overall quantitative probability requirement **for the risk on the ground** based on consensually established value of **maximum tolerable number of fatalities per flight hour** (which in principle might not be different from that applicable to manned aviation)*
    - *For the **risk in the air** (mid-air collision), due account of results on safety aspects (e.g. target levels of safety) from **Detect & Avoid related projects** like MIDCAS, ASTRAEA and others should be considered. Specific D&A projects for Light RPAS are required (see ULTRA-REC-REG-31)*
    - *For the **apportionment of probability requirements** applicable to Light RPAS systems, a **revision of the criteria currently used** in manned aviation should be conducted and **levels of complexity** of (Light) RPAS should be considered (see ULTRA-REC-REG-20).*
    - *For the **validation of safety objectives and requirements** it is crucial the use of data collected from experience with actual Light RPAS operations and the related incidents & accidents records. See ULTRA-REC-REG-04.*

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Regarding "airworthiness codes" for Light RPAS subject to airworthiness certification (ULTRA-REC-REG-06) ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-24: *Consider the following aspects when **developing airworthiness codes** for Light RPAS:*

- ***Requirements must be proportionate to the level of complexity** of the design (see ULTRA-REC-REG-20)*
- *A **"hybrid approach"** is recommended like that followed in STANAGs for Light RPAS (STANAG 4703 and 4738), which combines a set of **conventional airworthiness codes requirements** with **other types of qualitative criteria** (e.g. in STANAG 4703 and 4738 these are derived from the Essential Requirements of the Basic Regulation – Reg. EC 216/2008)*
- *Take into account the main **aircraft categories**, e.g. aerostats (balloons, airships), aerodynes (airplanes, rotorcrafts, …), taking into account that appropriate **special conditions** will have to be considered when the RPA **configuration is significantly unconventional**.*
- *For the **safety assessment and safety objectives** consider ULTRA-REC-REG-23.*
- *With regard to the **remote pilot station (RPS)**:*
  - *Consider the possibility of an **independent certification of the RPS**, in particular for the "larger" / more complex Light RPAS (as it is expected to be the case in the Large RPAS domain, where interoperable and certified RPS might also be able to control Light RPAS, at least those belonging to the "large" segment among Light RPAS).*
  - *Special focus on **human-machine interface (HMI) aspects** must be considered due to the lower degree of remote pilot / flight crew "situational awareness" compared to manned aviation.*

3.3.2.2. Approval of Design and Production Organizations

As described in ULTRA D1.1 [ref. R.5] and indicated in sec. 0, requirements for DOA (Design Organization Approval) and POA (Production Organization Approval) in Part 21 [ref. R.21] might be excessive for SMEs manufacturing Light RPAS, which in most cases are expected to be Light RPAS exempted from airworthiness certification or "low level complexity" Light RPAS. However, on the other hand, it is important to **ensure the adequacy and capacity of organizations intending to undertake design and production of Light RPAS** since such activities are at the core of the initial airworthiness concern. Besides, the level of the requirements to approve organizations undertaking those activities should be rather related to the **level of complexity of the Light RPAS being designed and produced** (see ULTRA-REC-REG-20), which is in line with the EASA Policy [ref. R.26] regarding the requirement for design organizations to be DOA or ADOA depending on the design complexity (requirement stemming from manned aviation).

Thus, ULTRA recommendation for European aviation authorities / regulators is:

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ULTRA-REC-REG-25: *For the **approval of organizations undertaking design and / or production of Light RPAS** consider the **level of complexity of the Light RPAS** (see ULTRA-REC-REG-20) being designed and produced:*

- ***Design and Production Organizations of Light RPAS exempted from airworthiness certification**: Consider recommendation ULTRA-REC-REG-09.*
- ***Design Organizations of Light RPAS subject to airworthiness certification**:*
  - *"Low complexity" Light RPAS. Consider alternative procedures to DOA (Part 21-like) ones, including:*
    - *Implementation of a **Safety Management System (SMS)**, including the elaboration of a **Safety Management Plan** (SMP)*
    - *Certification of the **organization quality system** in accordance with **(EN) ISO 9001**.*
    - *Use of a **Light RPAS certification programme** to show the organization design capability.*
  - *"Medium complexity" Light RPAS. Consider abovementioned requirements for "Low complexity" Light RPAS but for the organization quality system:*
    - *Certification of the **organization quality system** in accordance with **AS (EN) 9100**.*
  - *"High complexity" Light RPAS. Consider **"Part 21" or equivalent requirements for DOA** (Design Organization Approval).*
- ***Production Organizations of Light RPAS subject to airworthiness certification**:*
  - *"Low complexity" Light RPAS. Consider alternative procedures to POA (Part 21-like) ones, including:*
    - *Implementation of a **Safety Management System (SMS)**, including the elaboration of a **Safety Management Plan** (SMP)*
    - *Certification of the **organization quality system** in accordance with **(EN) ISO 9001** ("general purpose" quality system certification standard).*
    - *Approved programme for **inspection / audit** of the production process by the relevant **aviation authority or qualified entity**.*
  - *"Medium complexity" Light RPAS. Consider abovementioned requirements for "Low complexity" Light RPAS but for the organization quality system:*
    - *Certification of the **organization quality system** in accordance with **AS (EN) 9100** ("aviation, defence & space -oriented" quality system certification standard).*
  - *"High complexity" Light RPAS. Consider **"Part 21" or equivalent requirements for POA** (Production Organization Approval).*

3.3.2.3. Continuing Airworthiness

Likewise initial airworthiness, for continuing airworthiness in the longer-term and for Light RPAS subject to airworthiness certification, at least a **policy / guidance material** covering all the relevant aspects **must be developed**. As described in ULTRA D1.1 [ref. R.5], a number of national regulatory material (e.g. CAP722 [ref. R.35], TSFS 2009:88 [ref. R.38]) addressing Light RPAS are requiring for organizations

undertaking continuing airworthiness of Light RPAS subject to airworthiness certification that **manned aviation requirements and standards are followed**. However, rather than following directly manned aviation requirements and standards it might be more proportionate to consider the corresponding requirements to be related to the **level of complexity of the Light RPAS** subject to the continuing airworthiness activities

Thus, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-26: *For the **continuing airworthiness** activities:*

- *For Light RPAS exempted from airworthiness certification: Consider recommendations ULTRA-REC-REG-10 and ULTRA-REC-REG-11.*
- *For Light RPAS subject to airworthiness certification: **Develop policy / guidance material** for the **continuing airworthiness** activities with Light RPAS, indicating to what extent **"Part M"** (continuing airworthiness), **"Part 66"** (certifying staff), **"Part 145"** (maintenance organization approvals), and **"Part 147"** (maintenance training organization approvals) (see Reg. EU No 2042/2003) or **national equivalent** regulation(s) are applicable and what alternative approach (if any) can be followed and under what conditions. With regard to the **approval of related organizations**, see recommendation ULTRA-REC-REG-27.*

In the case of **organizations approval**, rather than following directly manned aviation requirements and standards it might be more proportionate to consider the corresponding **requirements to be related to the level of complexity of the Light RPAS** subject to the continuing airworthiness activities, as for the approval of design and production organizations (see ULTRA-REC-REG-25). Thus, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-27: *For the **approval of organizations undertaking continuing airworthiness activities**:*

- ***Continuing Airworthiness related Organizations for Light RPAS exempted from airworthiness certification**:: Consider recommendations ULTRA-REC-REG-10 and ULTRA-REC-REG-11.*
- ***Continuing Airworthiness related Organizations for Light RPAS subject to airworthiness certification**: Consider requirements based on Light RPAS complexity (see ULTRA-REC-REG-20):*
  - *"Low complexity" Light RPAS. Consider ULTRA-REC-REG-10 and, additionally:*
    - *Certification of the **organization quality system** in accordance with **(EN) ISO 9001**.*
  - *"Medium complexity" Light RPAS. Consider abovementioned requirements for "Low complexity" Light RPAS, additionally:*
    - *Certification of the **organization quality system** in accordance with **AS (EN) 9100** instead of ISO (EN) 9001.*
    - *Organization subject to **periodic inspection / audit** by relevant **aviation authority or***

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qualified entity.

- *"High complexity" Light RPAS. Consider requirements of **Reg. EC 2042/2003** ("Part M", "Part 66", "Part 145", "Part 147") or **equivalent national regulation**.*

3.3.3. Flight Crew Licensing and Training

For the regulation of licensing and training of remote pilots / flight crews for longer-term operations those aspect discussed in sec. 3.2.3 are also valid. However, the regulation will have to address the necessary requirements to ensure the **competency of remote pilots / flight crews in higher levels of complexity of the Light RPAS, the operations and the operational scenarios**.

"Good airmanship", in addition to the required theoretical knowledge and practical skills, is always an important quality to have in flight crews. "Airmanship" is defined by the FAA in ref. R.112 as:

- *A sound acquaintance with the principles of flight,*
- *The ability to operate an airplane with competence and precision both on the ground and in the air, and*
- *The exercise of sound judgment that results in optimal operational safety and efficiency*.

Such a quality is even more relevant when flight crews have to perform their duties in **more complex operational environments / scenarios**, reason why it has to be ensured when regulating the licensing and training of remote pilots / flight crews of Light RPAS in such environments / scenarios.

Thus, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-28: *For the **Light RPAS Flight Crew Licensing** the complexity of Light RPAS design, operations and operational environments / scenarios (see ULTRA-REC-REG-20) can be considered as follows:*

- ***Light RPAS exempted from airworthiness certification or "low complexity" design, and "low complexity" operations and operational environments/scenarios**: consider recommendation ULTRA-REC-REG-14.*
- ***Light RPAS subject to airworthiness certification and "mid to high complexity" design, and "mid to high complexity" operations and operational environments/scenarios**: consider.*
  - *A **deep theoretical knowledge on aviation fundamentals and "good airmanship"** ensured by requiring a **"professional pilot license"** from manned aviation (e.g. CPL, MPL, ATPL) or **valid professional unmanned pilot licence** (e.g. CPL(U)).*

    NOTE: The license from manned aviation does not need to keep current (as the currency of pilot skills on manned aircraft piloting is not relevant for piloting the RPAS) but the accumulated experience since the license was granted might be considered (a new examination might be required if not enough experience since license issuance)
  - *A **theoretical and practical training on the specific Light RPAS to be piloted** ("type*

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*rating") and the **intended type of operations**, imparted by the **approved operator** or an **approved organization** (approved training organization – ATO, see ULTRA-REC-REG-30). **Examination** might be considered to be evaluated by the relevant **civil aviation authority or a qualified entity** (a representative of the CAA or qualified entity might be the examiner).*

- *The **training programme must be approved by the relevant civil aviation authority,** and it might be required to include the use of a **Flight Simulator Training Device (FSTD)** or equivalent tool (see ULTRA-REC-REG-15 and ULTRA-REC-REG-29).*

With regard to the **Flight Simulator Training Device (FSTD)** or equivalent tools to be used for the training of remote pilots / flight crews, as in manned aviation these devices or tools should be in principle qualified by the relevant aviation authority, but this requirement should depend upon the level of training indicated in ULTRA-REC-REG-28.

ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-29: *For the qualification of **Flight Simulator Training Device (FSTD)** or equivalent tools to be used for the training of remote pilots / flight crews consider the training associated to:*

- ***Light RPAS exempted from airworthiness certification or "low complexity" design, and "low complexity" operations and operational environments/scenarios**: Consider recommendation ULTRA-REC-REG-15. **No need for FSTD / tool qualification** but the operator (or ATO) must **declare the suitability of such FSTD / tool** for the training programme in the corresponding operations manual (see ULTRA-REC-REG-18 or equivalent manual for ATO). As indicated in ULTRA-REC-REG-14, the training programme (including the use of FSTD / tool) is subject to approval by the relevant aviation authority or qualified entity.*
- ***Light RPAS subject to airworthiness certification and "mid to high complexity" design, and "mid to high complexity" operations and operational environments/scenarios**: Consider **requirements for qualification / approval for use of the FSTD / tool** in training of remote pilots / flight crews. It must be noted that the FSTD / tool might be installed or form part of the RPS and therefore the qualification might benefit from airworthiness requirements applicable to the RPS as part of the airworthiness certification process.*

Regarding the approval of organizations undertaking the training of remote pilots / flight crews (ATOs), ULTRA recommendation for European aviation authorities / regulators is:

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ULTRA-REC-REG-30: *For the **approval of organizations undertaking the training of remote pilots / flight crews (ATOs)** consider the **training programmes** addressed by the organization in terms of the **level of complexity** of (Light) RPAS, operations and operational environments / scenarios (see ULTRA-REC-REG-20) in which the remote pilots / flight crews are to be trained:*

- ***Light RPAS exempted from airworthiness certification or "low complexity" design, and "low complexity" operations and operational environments/scenarios**: Consider recommendation ULTRA-REC-REG-16.*
- ***Light RPAS subject to airworthiness certification and "mid to high complexity" design, and "mid to high complexity" operations and operational environments/scenarios**: Consider **similar requirements** to those for the **approval of a FTO** (Flight Trainining Organization) **/ ATO** (Approved Training Organization) **in manned aviation**.*

3.3.4. Operations and Operators

3.3.4.1. Operations

For the longer-term operations of Light RPAS, regulations will have to address operations in **non-segregated airspace**, in **all-weather and light conditions**, and **beyond the Very Low Level (VLL)** category (according to EUROCONTROL: VLOS, E-VLOS and B-VLOS), that is, **IFR/VFR Radio Line of Sight (RLOS) operations** and **IFR/VFR Beyond RLOS (BRLOS) operations**.

As it is well known, and described in ULTRA D1.1 [ref. R.5], the most important technological challenge for RPAS to be able to perform such operations is the **compliance with the "Rules of the Air"** and, in particular with the **"See and Avoid" principle** to avoid collisions with other air traffics, by using an **approved** (by aviation authorities) **Detect and Avoid (D&A) solution**. This **challenge is even greater for Light RPAS** since obviously the smaller and lighter the RPA the more **SWaP limitations** to equip the RPA with an onboard D&A solution.

R&D initiatives similar to those developed in Europe for large RPAS (MIDCAS [ref. R.103] and ASTRAEA [ref. R.104]) are also **required for Light RPAS** in order to **establish the technological and standardization principles** that must serve as a foundation for the development of D&A solutions suitable for Light RPAS an approvable by the relevant aviation authorities. Likewise, avoidance of terrain and ground obstacles as well as hazardous weather represent also a technological challenge to be addressed similarly to D&A of air traffics.

Thus, ULTRA recommendation for European aviation authorities / regulators and (industry) standardization organizations is:

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ULTRA-REC-REG-31: ***Support*** *the creation and* ***participation*** *in* ***R&D initiatives*** *to establish the* ***foundation elements for solutions applicable to Light RPAS*** *to efficiently and safely* ***detect and avoid*** *conflicts with other air traffics, terrain and ground obstacles as well as hazardous weather, enabling Light RPAS in non-segregated airpace beyond the limitations of short-term operations (see ULTRA-REC-REG-17. Such initiatives should be* ***pan-European*** *to facilitate deriving* ***"harmonized" safety requirements and standardization principles****.*

Since **Detect & Avoid solutions** for full compliance with the "see and avoid" principle and other "rules of the air" are **still years away** from existing and be approved by aviation authorities, **interim solutions** enabling a limited access to the non-segregated airspace **must be explored**, being the **ground based situational awareness solutions** among the most promising technological enablers. Thus, ULTRA recommendation for European stakeholders to be involved in (Light) RPAS operations is:

ULTRA-REC-REG-32: ***Stakeholders*** *to be involved in (Light) RPAS operations, in particular aviation authorities, industry, operators and ANSPs, should* ***explore jointly interim solutions*** *that can enable a limited access to the non-segregated airspace until Detect & Avoid solutions for full compliance with the "see and avoid" principle and other "rules of the air" are available. In particular the use of* ***ground based situational awareness solutions*** *should be explored, and the related safety requirements, standardization and associated procedures for the safety of operations should be defined.*

As indicated in ULTRA D1.1 [ref. R.5], a number of other issues are to be addressed in regulations and procedures in order to enable (Light) RPAS operations. Considering these issues, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-33: ***"Harmonized" criteria*** *and requirements at European and global level are required to address a number of operational aspects that can be considered* ***enablers of future Light RPAS operations*** *beyond the limitations of the short-term operations. In addition to the "Detect & Avoid" issue (see ULTRA-REC-REG-31 and ULTRA-REC-REG-32) other examples of such enablers are:*

- *An* ***equivalence*** *has to be established between the current requirements based on* ***human visual references*** *(quantitative or measurable) and those to be imposed to* ***RPAS technologies*** *for* ***compliance with the flight rules****.*
- ***Requirements and procedures*** *for Light RPAS* ***navigation based on GNSS*** *have to be defined.*
- ***Requirements on performance of the C3*** *(command & control and ATC communications), in particular the* ***availability, continuity, integrity and timeliness (latency)***
- *New or adaptation / modification of current* ***procedures*** *are required, due to (Light) RPAS specific characteristics that may* ***affect current ATM*** *procedures, including* ***flight planning format and processes*** *used for operations in* ***controlled airspace****:*
    - ***Specific RPA flight performances*** *(e.g. lower climb/descent rate and cruise speed than*

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manned aircraft)

- o ***Normal specific RPA flight profiles*** *(long-duration flights, loitering above specific area, specific flight patterns …)*
- o ***Emergency procedures and emergency specific RPA flight profiles*** *(e.g. loss of link procedures, automatic fly to emergency/recovery zone or return to base, backup means for pilot-ATC communication …)*

- *Specific **requirements** for **safety of operations** when using **non-conventional** manoeuvres and methods for **launch & recovery**.*
- *Specific **requirements and procedures** to address **RPS handover** and **other RPS-related** issues.*

Considering abovementioned issues and the relevance of the level of complexity of Light RPAS, operations and operational environments / scenarios, ULTRA recommendation for European aviation authorities / regulators for the Light RPAS operations approval is:

ULTRA-REC-REG-34: *In order to enable long-term operations of Light RPAS **beyond the limitations of the short-term operations** (ULTRA-REC-REG-17) consider the **level of complexity** of (Light) RPAS, operations and operational environments / scenarios (see ULTRA-REC-REG-20) for the approval as follows:*

- ***Light RPAS exempted from airworthiness certification or "low complexity" design, and "low complexity" operations and operational environments/scenarios**: Consider recommendation ULTRA-REC-REG-17.*
- ***Light RPAS subject to airworthiness certification and "mid to high complexity" design, and "mid to high complexity" operations and operational environments/scenarios**: Among the requirements to be considered are:*
  - o ***Approval of the operator**, in accordance with ULTRA-REC-REG-35.*
  - o ***Operations out of VLOS** will require a **Detect and Avoid**, either a **full capable solution** for non-restricted operations or, if not available, a **limited interim solution** (e.g. a ground based situational awareness solution) with **associated operational restrictions and procedures** to ensure the safety of operations (see ULTRA-REC-REG-32)*
  - o *The **Light RPAS must be equipped in accordance with the intended operations** in the selected airspace class(es). Specific **requirements and procedures** must be defined to deal with **(Light) RPAS specificities** as indicated in ULTRA-REC-REG-33.*

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3.3.4.2. Operators

For **longer-term operations** involving the use of Light RPAS subject to airworthiness certification (thus, more complex RPAS) as well as more complex operations and operational environment / scenarios **additional regulatory requirements for operators approval will be necessary** to ensure that these organizations can perform operations safely. Again, as in the case of other organizations approval (see ULTRA-REC-REG-25, ULTRA-REC-REG-27 and ULTRA-REC-REG-30), the **complexity** of the Light RPAS used, the operations performed and the related operational environment / scenarios can be considered the **major driver for the difference in requirements for the operator approval**.

Thus, ULTRA recommendation for European aviation authorities / regulators is:

ULTRA-REC-REG-35: *For the **approval of Light RPAS operators** the **complexity** of Light RPAS design, operations and operational environments / scenarios (see ULTRA-REC-REG-20) can be considered as follows::*

- ***Light RPAS exempted from airworthiness certification or "low complexity" design, and "low complexity" operations and operational environments/scenarios**: Consider recommendation ULTRA-REC-REG-17.*
- ***Light RPAS subject to airworthiness certification and "mid to high complexity" design, and "mid to high complexity" operations and operational environments/scenarios**: In addition to requirements recommended in ULTRA-REC-REG-17, consider:*
  - *The operator must hold a valid and current **certificate of airworthiness or equivalent authorization** (issued by the relevant aviation authority) for each Light RPAS to be operated (see ULTRA-REC-REG-22, ULTRA-REC-REG-23, and ULTRA-REC-REG-24)*
  - *The organization must include a **continuing airworthiness management organization** (CAMO) or, at least a person responsible of the corresponding CAMO activities.*
  - *If the operator intends to perform **MRO activities**, it has to **be approved** for such activities. See ULTRA-REC-REG-27. Likewise, if the operator contracts such activities to other organization, that organization has to be approved with the same criteria.*
  - *If the operator intends to perform the **licensing and training** of its **remote pilots / flight crews**, it has to **be approved** for such activities. See ULTRA-REC-REG-30. Likewise, if the operator contracts such activities to other organization, that organization has to be approved with the same criteria.*
  - *The relevant **aviation authority or nominated qualified entity inspects the organization** prior to the approved, and periodic inspections / audits are performed afterwards.*

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3.4. Summary of ULTRA Recommendations for Regulatory Gaps

Table 3-2 below identifies by the corresponding reference those recommendations provided by ULTRA in sec. 3 to overcome the Regulatory & Standardization "gaps" identified in ULTRA D1.1 [ref. R.5] and summarized in sec. 2

<table>
<tr><th colspan="2" rowspan="2">Regulatory & Standardization Gaps</th><th colspan="2">ULTRA Recommendations</th></tr>
<tr><th>For Short-Term OPS</th><th>For Long-Term OPS</th></tr>
<tr><td rowspan="5">General (overall)</td><td>RG-1: Harmonization in regulations and standards at European level</td><td colspan="2" rowspan="3">ULTRA-REC-REG-01
ULTRA-REC-REG-02
ULTRA-REC-REG-03</td></tr>
<tr><td>RG-2: Harmonization in regulations and standards at International level</td></tr>
<tr><td>RG-3: Civil-Military Harmonization</td></tr>
<tr><td>RG-4: Globally agreed classification scheme for RPAS</td><td>ULTRA-REC-REG-05
ULTRA-REC-REG-06</td><td>ULTRA-REC-REG-06
ULTRA-REC-REG-20
ULTRA-REC-REG-21</td></tr>
<tr><td>RG-5: Lack of safety-related data and limited familiarization of authorities (and other stakeholders) with RPAS</td><td colspan="2">ULTRA-REC-REG-04</td></tr>
<tr><td rowspan="2">Airworthiness</td><td>RG-6: “Harmonized approach” for Initial Airworthiness of Light RPAS</td><td>ULTRA-REC-REG-06
ULTRA-REC-REG-07
ULTRA-REC-REG-08</td><td>ULTRA-REC-REG-06
ULTRA-REC-REG-07
ULTRA-REC-REG-22</td></tr>
<tr><td>RG-7: “Harmonized approach” for Continuing Airworthiness of Light RPAS</td><td>ULTRA-REC-REG-10
ULTRA-REC-REG-11</td><td>ULTRA-REC-REG-10
ULTRA-REC-REG-11
ULTRA-REC-REG-26</td></tr>
</table>

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Regulatory & Standardization Gaps		ULTRA Recommendations	
		For Short-Term OPS	For Long-Term OPS
	RG-8: "Harmonized" Safety Objectives applicable to Light RPAS in their different categories		**ULTRA-REC-REG-23**
	RG-9: "Harmonized" Airworthiness Codes for Light RPAS		**ULTRA-REC-REG-24**
	RG-10: Harmonized requirements for Light RPAS Design, Production and Maintenance Organisations	**ULTRA-REC-REG-09**	**ULTRA-REC-REG-09** **ULTRA-REC-REG-25** **ULTRA-REC-REG-27**
Flight Crew Licensing & Training	RG-11: "Harmonized" requirements for Flight Crew Licensing & Training	**ULTRA-REC-REG-13** **ULTRA-REC-REG-14**	**ULTRA-REC-REG-13** **ULTRA-REC-REG-14** **ULTRA-REC-REG-28**
	RG-12: "Harmonized" requirements for Flight Simulation Training Devices (FSTD)	**ULTRA-REC-REG-15**	**ULTRA-REC-REG-15** **ULTRA-REC-REG-29**
	RG-13: "Harmonized" requirements for Approval of Training Organizations (ATO)	**ULTRA-REC-REG-16**	**ULTRA-REC-REG-16** **ULTRA-REC-REG-30**
Operations, Use of Airspace and Launch & Recovery Sites	RG-14: "Harmonized" requirements and procedures for RPAS operations	**ULTRA-REC-REG-17**	**ULTRA-REC-REG-17** **ULTRA-REC-REG-33** **ULTRA-REC-REG-34**
	RG-15: "Harmonized" requirements for avoidance of collision with other air traffics	**ULTRA-REC-REG-17**	**ULTRA-REC-REG-31** **ULTRA-REC-REG-32**
	RG-16: "Harmonized" requirements for avoidance of collision with terrain / obstacles		

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Regulatory & Standardization Gaps		ULTRA Recommendations	
		For Short-Term OPS	For Long-Term OPS
	RG-17: "Harmonized" requirements for avoidance of hazardous weather		
	RG-18: "Harmonized" requirements for communications (C3)	**ULTRA-REC-REG-17**	**ULTRA-REC-REG-17** **ULTRA-REC-REG-33**
	RG-19: "Harmonized" requirements for Operators	**ULTRA-REC-REG-18**	**ULTRA-REC-REG-18** **ULTRA-REC-REG-35**

Table 3-2: Summary of ULTRA Recommendations for Regulatory & Standardization Gaps

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4. CONCLUSIONS

This report has provided a set of recommendations to address the regulatory and standardization "gaps" identified in ULTRA D1.1 [ref. R.5] in two stages and corresponding timeframes:

- Set of **recommendation for short-term operations** (sec. 3.2), in order to enable use cases like those identified in ULTRA D4.1 [ref. R.6] as potential "quick wins".
- Set of **recommendation for longer-term operations** (sec. 3.3), in order to enable non-restricted access to non-segregated airspace.

Most of these recommendations are intended for **aviation authorities / regulators** but a number of them address also the **Light RPAS industry** (Light RPAS manufacturers and standardization organizations) and **operators**.

As it has been discussed, an **important initial step** for the regulation and standardization of (Light) RPAS is **agreeing upon a classification scheme**. Even though for short term operations the RPA mass and operation range (VLOS/BVLOS) are the most used parameters for classification, for longer term operations other (additional) aspects might be considered. ULTRA recommends considering the **levels of complexity** of the (Light) **RPAS** (its design, in particular its level of autonomy and complexity of hardware and software), the **operation**, and the **operational environment / scenario**. Thus a definition of these levels of complexity should be undertaken jointly by the main affected stakeholders (aviation authorities / regulators, industry and operators)

As highlighted in this report, the underlying principle for all ULTRA recommendations is that the **proposed actions can favour a "harmonization" in regulations and standards applicable to Light RPAS**. However, since fostering Light RPAS operations in the shortest timeframe is a EU/EC priority in the RPAS domain, and considering that Light RPAS fall under the remit of the European national authorities, thus, promoting the **promptest adoption of the required regulatory requirements by these national authorities to allow the accommodation of Light RPAS operations is the first priority even if those requirements are not (fully) harmonized across Europe**, in other words, it is deemed better to have in the shortest term national regulations in place addressing Light RPAS, even if not "harmonized" at European level, than waiting until such "harmonization" process could be mature enough and subsequently adopt those "harmonized" requirements at national level.

Nevertheless, following ULTRA recommendations for short-term operations of Light RPAS (within 5 years from now) might **facilitate a set of safety requirements enabling the "quick win" use cases identified by ULTRA** in D4.1. Likewise, following ULTRA recommendations for longer-term operations of Light RPAS (by 10-15 years from now) might facilitate the expected **future effort on "levelling" the most significant differences among European national regulations**, thus paving the way for a future European level regulation when EASA remit is extended to cover also Light RPAS.

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