State-of-the-art of mass-market drones standards

D3.3

AW-Drones

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AW-Drones

Abstract

This document summarizes the data collection and structuring work that was performed as a part of work package 3 of the AW-Drones project. The purpose for the data collection effort and the overall approach is presented. Furthermore, the structure of the data collection document and its content relating to drone standards is explained. It will give an overview of what kind of data is being collected, how the data is categorized and how it is mapped to the ongoing regulatory process for UAS. This document concludes with an outlook to the further work of the project on the state of the art of standards documents.

The initial version of this document (D3.1) presented the first data collection and a 'mapping' of the standards to airworthiness requirements. The 2nd iteration of the document (D3.2) described the updated status of the data collection, including the feedback of assessment data and the approach to include U-Space requirements. Finally, the 3rd iteration of the document (D3.3) again describes the updated status of the data collection, including the feedback of assessment data and the approach to include the requirements for the Special Condition for Light Unmanned Aircraft Systems - Medium Risk (SC Light-UAS).

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Table of Contents

1. Introduction

The lack of clear standards is holding back the development of drone-related business, both at a global level and in Europe. Several studies and surveys identify a reliable regulatory and standardization framework as one of the main potential boosters for the drone business. Therefore, to foster the growth of a safe drone usage, there is a need to implement coherent and interoperable global standards and regulations for drones in the EU. The European Union's Horizon 2020 Research and Innovation Program funded AW-Drones to tackle these issues and guide future EU drone regulation.

AW-Drones contributes to harmonize the EU drone regulation and standards, supporting the rulemaking process for the definition of rules, technical standards and procedures for civilian drones to enable safe, environmentally sound and reliable operations in the European Union. In order to achieve this, one of the sub-goals of the project, is to propose and validate a well-reasoned set of technical standards for operations, appropriate for all relevant categories of drones.

A work plan has been formulated to collect and assess existing and planned standards. The effort is split into three work packages (WP):

- WP2 - Development of a methodology for categorization and assessment
- WP3 - Collection and categorization of standards that might be applicable for UAS
- WP4 - Assessment of these standards to evaluate their feasibility to support this process in order to derive a set of standards that are validated and found applicable

This deliverable will give an overview about the second aforementioned point (WP3). It refers directly to a document called 'Collection of UAS standards' which contains the actual data and will be explained in the next section.

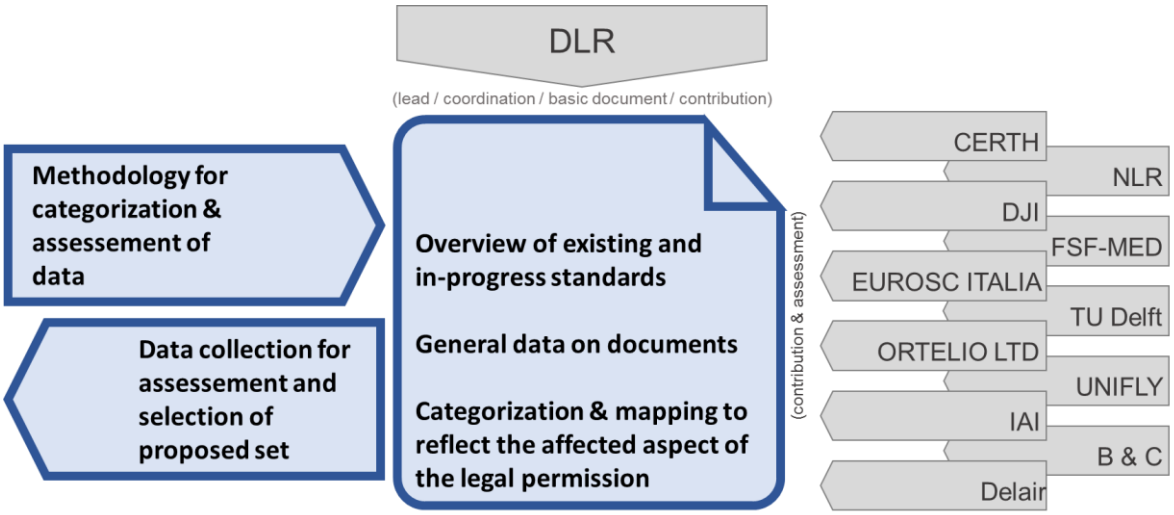

Figure 1-1: data collection input and involved partners

The figure above gives an overview about how the data collection work is linked to other parts of the project. The work package is led by DLR with strong contributions by all partners. They provided:

- Expertise and background knowledge on collecting UAS related standards
- Support on the categorization and assessment of the standards

During the project kick-off meeting it was discussed and decided that the focal point of the project should be to support the ongoing process in EU and EASA as best as possible [1]. It was agreed that the data collection should have a high bandwidth and especially cover specific category drones as this class of drones is applicable to many use-cases. The regulatory process is ongoing and there should be numerous standards which might be applicable to act as an Acceptable Means of Compliance (AMC) in the later process.

As the JARUS Specific Operations Risk Assessment (SORA) process is now adapted into a regulatory framework with ED2019/947 [2] it was decided [1] that the categorization shall be made in accordance with the SORA process with focus on the Specific category up to SAIL 4 for the first iteration of the data collection. More specifically, the standards shall be linked to the OSOs and ground/air risk mitigations that are proposed by SORA. This will be a first step for the assessment of a standard as a possible AMC to this OSO/mitigation and the input to WP 4. Furthermore, from the number and general data of the standards a first impression of gaps will be visible.

For its second iteration the document and the relation to U-Space it was decided to refer to the recently published EASA opinion on U-Space structure [11] and its appendixes [12]. As the progress of defining the U-Space structure is still ongoing the requirements given are high level requirements and may not be appropriate for the assessment of the standards. However, for the mapping of standards to the relevant requirements / topics this input may be used. The identified requirements are described in section 4.

For the third iteration it was decided to refer the collected standards to the requirements of the Special Condition for Light Unmanned Aircraft Systems - Medium Risk (SC Light-UAS) [13][11]. The identified requirements are described in section 6.

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The starting point for the collection of data shall be the EUSCG Rolling Development Plan [6] as stated in the Grant Agreement [4] and in the KOM [1]. It provides an overview of a large number of UAS standards related to UAS. However, this source will be complemented with other data, e.g. ANSI roadmap and own literature studies. There is special importance placed on the collection of UAS related standards from ANSI [7] and ASTM [8], as they cover a huge amount of documents and are obviously very much complete about the standards by these Standards Design Organizations (SDOs). From the first to the second iteration of the document the data was updated from the SDOs databases for all documents (04/2020). Additionally, documents derived from the two EASA workshops and the workshops at EUROCONTROL were added.

2. Collection of UAS standards

The format of the data collection of UAS standards is an Excel file that contains the standards line wise. The format was chosen as it provides the most flexibility between functionality (e.g. filtering) and a format that can be edited by all partners.

The header of the file contains several sections that are presented in the schematic below. It contains four sections.

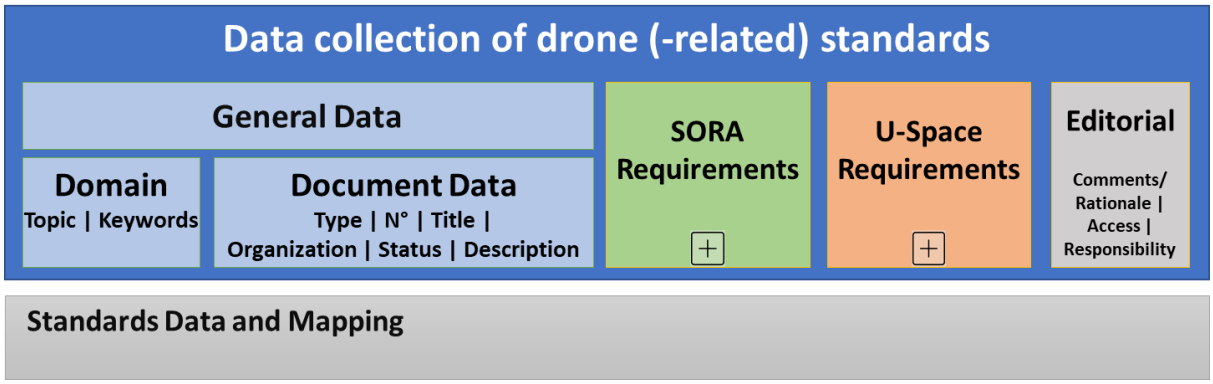

Figure 2-1: Header of Data Collection Document

The first section 'General Data' (blue) contains general data on the document, such as document reference number, responsible SDO and title. Also, a short description is included here, if there is any abstract or similar accessible. Furthermore, a categorization into a domains and keyword system is made. This is helpful to 'scan' the document for standards in a specific topic, which might be a common use-case for the document. In the first iteration of the data collection a domain and subdomain system was used. From workshop input this was changed to a domain and keywords system. Each standard is assigned to the domain that is most appropriate. Each domain is associated with different keywords that represent subtopics within this domain. A standard can have up to three keywords to characterize its content. For the keyword 'systems and equipment' there are again second level keywords to further detail if necessary. The categorization structure is an input from WP 2 and part of the methodology (as described in D2.1 [9]). It is also included on the second work sheet of the data collection document and in the Annex of this document. The topics that are relevant for UAS regulation are split into domains and keywords.

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The second section ‘SORA Requirements’ (green) contains all the OSOs and mitigations that are identified from the SORA process [10]. The details about this section are given in chapter 3.

The third section ‘U-Space Requirements’ (red) contain the requirements identified from EASA opinion on U-Space structure [11], [12]. The details about this section are given in chapter 4.

The last section ‘Editing’ (grey) contains information which is necessary to do the mapping to the SORA step. The work is distributed among the partners. The partner in charge is recognized as ‘responsible’ and within the columns for ‘mapped it is indicated, if the mapping to SORA or U-Space requirements was performed. Each standard can be complemented with a comment or a short rationale for the mapping. Finally, the assessment performed in WP4 is also marked here.

As described before, the basis for data collection is the EUSCG Rolling Development Plan. A first structure of the overview was also derived from this collection. However, the Domains were changed in a later process to the ones derived by WP2.1 Methodology and later updated to the keyword system established by the workshops and included in WP2 updated. The additional data sources are explained above.

The first iteration of the data collection table contained one more section to divide the standards into applicable drone categories open, specific, certified as accepted by EASA with 2019/945 [3] and 2019/947 [2]. As this was found to be redundant with information from SORA requirements and not relevant for U-Space requirements it was removed for the second iteration.

3. Mapping to SORA requirements

As mentioned in the previous chapter the second section of the header represents the Operational Safety Objectives and Mitigations for Ground and Air Risk that are addressed from the current version 2.0 of SORA. A schematic with a detailed view on the subsections of the SORA requirements is shown in Figure 3-1.

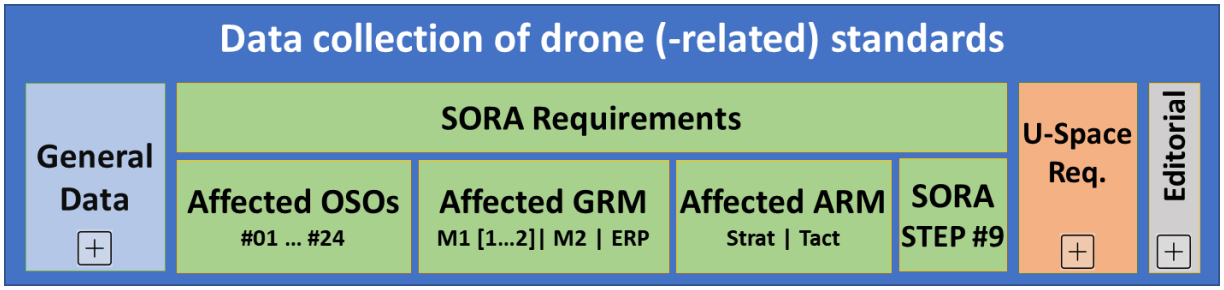

Figure 3-1: Header of data collection with detailed SORA requirements

The OSOs included in the header are shown in Table 1.

Table 1: Operational Safety Objectives considered from JARUS SORA process

Technical OSOs	#01	Ensure the operator is competent and/or proven
	#02	UAS manufactured by competent and/or proven entity
	#03	UAS maintained by competent and/or proven entity
	#04	UAS developed to authority recognized design standards
	#05	UAS is designed considering system safety and reliability
	#06	C3 link characteristics (e.g. performance, spectrum use) are appropriate for the operation
	#07	Inspection of the UAS (product inspection) to ensure consistency to the ConOps
Operational	#08	Operational procedures are defined, validated and adhered to (to address technical issues with the UAS)
	#11	Procedures are in-place to handle the deterioration of external systems supporting UAS operation
	#14	Operational procedures are defined, validated and adhered to (to address human errors)
	#21	Operational procedures are defined, validated and adhered to (to address Adverse Operating Conditions)
Remote crew	#09	Remote crew trained and current and able to control the abnormal

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training		and emergency situations (i.e. Technical issue with the UAS)
	#15	Remote crew trained and current and able to control the abnormal and emergency situations (i.e. Human Error)
	#22	The remote crew is trained to identify critical environmental conditions and to avoid them
Safe design	#10	Safe recovery from technical issue
	#12	The UAS is designed to manage the deterioration of external systems supporting UAS operation
Deterioration of external systems supporting UAS operation	#13	External services supporting UAS operations are adequate to the operation
Human Error	#16	Multi crew coordination
	#17	Remote crew is fit to operate
	#18	Automatic protection of the flight envelope from human errors
	#19	Safe recovery from Human Error
	#20	A Human Factors evaluation has been performed and the Human-Machine Interface (HMI) found appropriate for the mission
Adverse Operating Conditions	#23	Environmental conditions for safe operations defined, measurable and adhered to
	#24	UAS designed and qualified for adverse environmental conditions (e.g. adequate sensors, DO-160 qualification)

Table 2 provides an overview about the mitigations for ground and air risk extracted from the SORA process. An additional point which is included is step N°9 from the SORA methodology. The reason for this additional point is, that step 9 must be shown by AMCs and is not represented by any of the OSOs or mitigations.

Table 2: Ground and Air Risk Mitigations considered from JARUS SORA process

Ground Risk Mitigations	**M1 (Generic)**	**Strategic M.**	M1 S#1	Definition of the ground risk buffer
			M1 S#2	Evaluation of people at risk
		Tethered operation	M1 T#1	Technical Design of tether
			M1 T#2	Procedures for tether installation & control
	M2 (Effects of ground impact)		M2 #1	Technical Design for ground impact
			M2 #2	Procedures for equipment installation
			M2 #3	Training for ground impact measures
	ERP		M3 #1	Emergency Response Plan
Collision Risk (Air Risk)	**Strategic Mitigation**	**Operational Restrictions**	Boundary	Mitigations that bound the geographical volume in which the UAS operates
			Chronology	Mitigations that bound the operational time frame
			Time of Exposure	Mitigations that bound the time of exposure
		Common Structures	Common Flight Rules	Mitigations by setting a common set of rules which all airspace users must

		and Rules		comply with
			Common Airspace Structure	Mitigations by controlling the airspace infrastructure through, physical characteristics, procedures, and techniques
	Tactical Mitigation	**VLOS**	VLOS	Tactical mitigation with the remaining well clear and avoiding collisions requirements
		BVLOS	Detect	Define Detection with adequate precision for the avoidance maneuver (ARC-a to ARC-d)
			Decide	Define Decide with adequate precision for the avoidance maneuver (ARC-a to ARC-d)
			Command	Define Command with adequate precision for the avoidance maneuver (ARC-a to ARC-d)
			Execute	Define Execute with adequate precision for the avoidance maneuver (ARC-a to ARC-d)
			Feedback loop	Define feedback loop with adequate precision for the avoidance maneuver (ARC-a to ARC-d)
SORA Step #9			Containment	Containment requirements for adjacent airspace and area considered

The mapping to the SORA process is the second step after the collection of the data. It is the basis for further assessment of the standards. The mapping of the standards is distributed among the project partners and merged by DLR. For each standard a partner is in the role of the 'responsible' who does the mapping and includes a short rationale to explain the decisions. This is done on a very high level and based on available data on the documents, like abstracts/summaries, table of contents and, if available, the actual content of the standards.

After the first iteration 298 standards (approximately 47%) were mapped to the requirements.

The current status is that 524 standards (approximately 80%) of the documents are mapped.

Validation with EASA experts

The data collection work was presented to EASA experts during a two-day workshop [5] during the first iteration of the document and a second workshop during the second iteration. However, for the second workshop the focus was on the assessment data. The overall approach was shown during the plenary of the workshop and the data collection document was reviewed during group activities.

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The structure and the approach of WP3 and WP4 were reviewed as well as feedback was given (to WP3) to the domains (resulting in the update to the presented keyword system), the completeness of the data (and standards were added) and the mapping.

4. Mapping to U-Space requirements

The second iteration of the data collection is supposed to include requirements coming from U-Space implementation and to connect the data collection to these requirements. In March 2020 EASA published its Opinion 01/2020 'High-level regulatory framework for the U-space' [11] focusing on the possible architecture of U-Space and connected services. This document gives intended guidelines on a very high level and therefor only high-level requirements may be identified. As Annex to this opinion a draft for the implanting regulation of U-Space structure was published following the same approach and going one step further to a 'technical' description. Figure 4-1 summarizes the documents used as input.

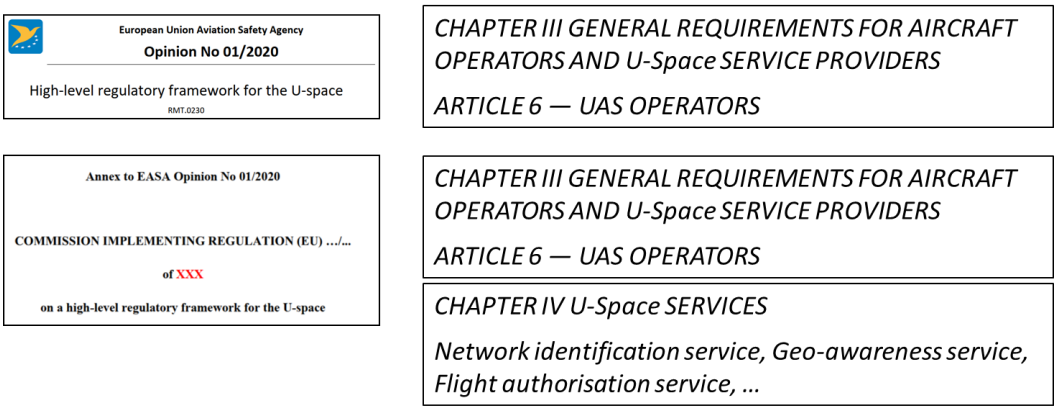

Figure 4-1: Identification of U-Space requirements

In both documents, chapters can be found giving requirements towards UAS operators as well as service providers. The requirements from the Annex were found to be more topic-like and closer to technical matters and were therefor primarily considered and expanded by requirements from the opinion itself. A large part of the requirements is directly connected to the planned U-Space services and gives content that shall be related to each service. Additionally, there are few high-level requirements e.g. occurrence reporting.

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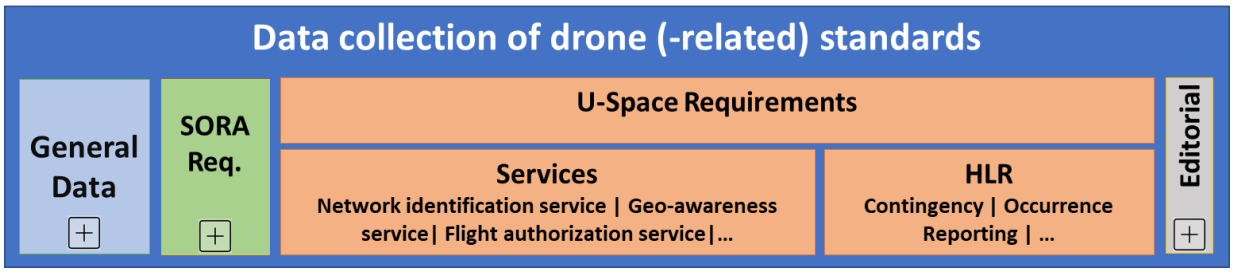

Figure 4-2: Header of data collection with detailed U-Space requirements

The requirements found for the services where grouped and, together with the high-level requirements added to the data collection document. A schematic with a detailed view on the subsections of the U-Space requirements is shown in Figure 4-2.

The requirements included in the table are shown in more detail in Table 3.

Table 3: U-Space Service and General Requirements considered from EASA Opinion

U-Space Service Requirements	Network Identification Service	RemoteID, Message Publication, Traffic Information
	Geo-awareness Service	Operational Data, CIS, Airspace Information
	Flight authorization service	Flight authorization, Restrictions & De-confliction, Priorities
	Traffic information service	Enroute Traffic (Position, Time, Speed, Course, Status), Update Frequency
	Tracking service	Telemetry, Ground based surveillance, Reporting, Recording, Alerting
	Weather information service	Weather Information Data (Wind, Visibility, Clouds, Temp.), Forecast
	Conformance monitoring service	Conformance Monitoring, Alertion
	Common Information Service	
General U-Space Requirements	Occurrence Reporting	
	Contingency & Emergency Management	
	Communication Service	

All standards connected to the U-Space and Aerodromes domains were mapped to the identified requirements and can act as an input for a more detailed view in WP4 context.

5. Incorporation of Assessment Data

After the assessment on the standards was performed in WP4 to further study the fulfillment of SORA requirements by the standards it was identified that it will be crucial to align the data from WP4 and WP3 and feedback the relevant information into the data collection document. It was therefore decided during project meetings, that the 'effectiveness to fulfill SORA req.' established in WP4 shall be included into the data collection table.

Two sheets were added into the data collection document. The header of these sheets resembles the structure for assessment details in D4.1 and include each OSO for the first sheet and each mitigation and SORA step9 for the second sheet. The data below this header are the standards with one standard per line, like in the first sheet of the table. The overall header is too large to be shown here, but Figure 5-1 shows a section containing OSO3 as an example.

OSO REQUIREMENTS P = Partial Coverage, F = Full Coverage, NS = No standard required, OS = Out of scope for SAIL up to IV				ASSESSED	OSO 03 – UAS maintained by competent and/or proven entity						
					Criterion 1			Criterion 2			Gaps/Comments
					Procedures			Training			
					L	M	H	L	M	H	
1	AS####	UAS Propulsion System Terminology	SAE E-39 Unmanned Aircraft Propulsion Committee								

Figure 5-1: Assessment data feedback to data collection

The feedback is included by all partners by entering the identified effectiveness in the table as partial, full, not required or out of scope. Additionally, comments and identified gaps will be entered for each requirement. This process is currently ongoing and will be finalized in the third iteration.

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6. Mapping to SC Light-UAS requirements

Structure of New Data

In the third and final iteration, the data collection is augmented by the requirements defined in the new EASA Special Condition Light Unmanned Aircraft Systems - Medium Risk [13]. This document was issued by EASA in December 2020. This Special Condition defines airworthiness requirements for unmanned aircraft operated in the specific category on the basis of objectives. This is a major difference to earlier approaches, which have been prescriptive in nature. EASA decided to develop a dedicated SC for light UAS, since objective based CS are deemed more appropriate for UAS.

This section details the work on identifying SC Light-UAS requirements and describes the integration into the collection of standards. A schematic with a detailed view on the updated data collection structure is shown in Figure 6-1.

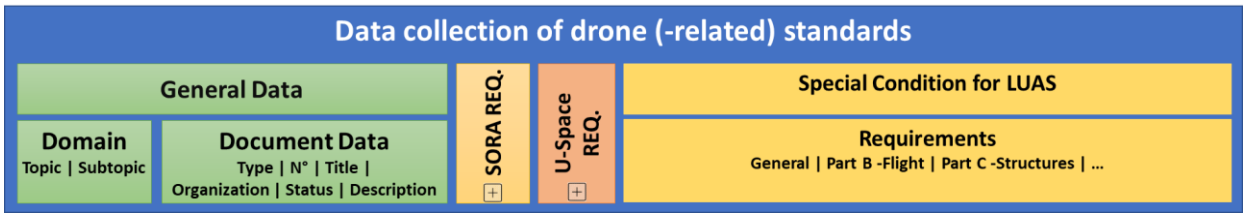

Figure 6-1: Heather of data collection with augmented requirements from SC LUAS

Details of Requirements Selection

The SC Light-UAS document defines objective requirements. For this iteration, EASA proposed a selection of requirements and additionally a preliminary classification of these SC Light-UAS requirements to OSO requirements. These requirements will be detailed in Table 4. This proposed list includes 44 requirements. However, it should be noted that there are two versions available for SC Light-UAS, a proposed version from 20.7.2020, and a final version from 17.12.2020. There are some differences in the set of requirements between these versions. With four exceptions, the proposed list includes all requirements from the final version of SC Light-UAS. As a result, the list in table 4 includes 48 requirements. One exception is the requirement Light-UAS.2410, as detailed below. This requirement has been mapped to the list of standards and is marked in green in the requirement list.

- Light-UAS.2410 Lift/Thrust/Power Endurance and durability

The other three exceptions are discussed in the next subsection. Additionally, the list includes four requirements that are included in the final version of SC Light-UAS, but are not listed in the table of contents for the document. These requirements are marked gray for clarification.

Limitations of Requirements Mapping

There are three requirements from the SC Light-UAS that have not been mapped to standards, but are however included in the list for completeness (marked in red). These requirements were not part of the EASA proposed list of requirements. Specifically, these requirements are:

- Light-UAS.2000 Applicability and Definitions
- Light-UAS.2010 Accepted Means of Compliance
- Light-UAS.2500 Systems and equipment function – General

These requirements are general definitions of the document itself. Light-UAS.2000 defines the scope of the document, the requirement Light-UAS.2010 discusses the term acceptable means of compliance, and Light-UAS.2500 defines how following requirements should be handled. Therefore, it was concluded that it would not be meaningful to map these requirements to standards.

Table 4: SC Light-UAS objective airworthiness requirements:

Requirements marked red are not mapped,

Requirements marked in green are were not in the list of proposed requirements by EASA,

Requirements highlighted gray are not listed in the SC Light-UAS table of contents.

Subpart	SC Requirements	OSO	SAIL III Robustness	SAIL IV Robustness
A - General	Light-UAS.2000 Applicability and Definitions			
	Light-UAS 2005 Definition of the operational scenario	N/A	N/A	N/A
	Light-UAS.2010 Accepted Means of Compliance			

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B - FLIGHT	Light-UAS.2100 Mass and center of gravity	4	L	L
	Light-UAS.2102 Approved Flight envelope and environmental conditions	4	L	L
	Light-UAS.2105 Performance data	4; 24		
	Light-UAS.2135 Controllability, maneuverability and stability	4	L	L
	Light-UAS.2160 Vibration and Buffeting	4	L	L
C - STRUCTURES	Light-UAS.2235 Structural Strength and deformation	4	L	L
	Light-UAS.2240 Structural durability	4	L	L
	Light-UAS.2250 Design and construction principles	4	L	L
	Light-UAS.2260 Materials and Processes	4	L	L
D –DESIGN AND CONSTRUCTION	Light-UAS.2300 UA flight control systems	4	L	L
	Light-UAS.2305 Landing gear systems	4	L	L
	Light-UAS.2325 Fire protection	4	L	L
	Light-UAS.2335 Lightning protection	24	M	H
	Light-UAS.2340 Design and construction information	4	L	L

	Light-UAS.2350 Forced landing or a crash	5	L	M
	Light-UAS.2370 Transportation, assembly, reconfiguration and storage	4	L	L
	Light-UAS.2375 Payload Accommodation	5	L	M
	Light-UAS.2380 Ancillary Equipment not permanently installed on the UA	4; 13	L; M	L; H
E – LIFT/THRUST/POWER SYSTEM INSTALLATION	Light-UAS.2400 Lift/Thrust/Power systems installation	4; C) linked to OSO 5	L; L	L; M
	Light-UAS.2405 Lift/Thrust/Power System Integrity	4	L	L
	Light-UAS.2410 Lift/Thrust/Power Endurance and durability			
	Light-UAS 2415 Lift/Thrust/Power Calibration, Ratings and Operational Limitation	4	L	L
	Light-UAS.2430 Energy storage and distribution systems	4; 5	L; L	L; M

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F – SYSTEMS AND EQUIPMENT	Light-UAS.2500 Systems and equipment function - General			
	Light-UAS.2505 General Requirement on Equipment Installation			
	Light-UAS.2510 Equipment, Systems and Installation	5; 10/12; 19	L; M; L	M; M; M
	Light-UAS.2511 Containment	Step 9	N/A	N/A
	Light-UAS.2512 Mitigation Means linked with Design	M1 / M2	Low/Medium/High	Low/Medium/High
	Light-UAS.2515 Electrical and electronic system lightning protection	24	M	H
	Light-UAS.2520 High-Intensity Radiated Fields (HIRF) Protection	24	M	H
	Light-UAS.2528 UAS Envelope protection Function	18	L	M
	Light-UAS.2529 UAS Navigation Function	4	L	L
	Light-UAS.2530 UA External lights	4	L	L
	Light-UAS.2575 Command, Control and Communication Contingency	5	L	M

G – REMOTE CREW INTERFACE AND OTHER INFORMATION	Light-UAS.2600 Command Unit Integration	4	L	L
	Light-UAS.2602 Command Unit	20	L	M
	Light-UAS.2605 Command Unit Installation and operation information	20	L	M
	Light-UAS.2610 Instrument markings, control markings and placards	4	L	L
	Light-UAS.2615 Flight, navigation, and thrust/lift/power system instruments	20	L	M
	Light-UAS.2620 Flight Manual			
	Light-UAS.2625 Instructions for Continued Airworthiness (ICA)			
H - C2 Link	Light-UAS.2710 General Requirements	6	L	M
	Light-UAS.2715 C2 Link Performances	6	L	M
	Light-UAS.2720 C2 Link Performance monitoring	6	L	M
	Light-UAS.2730 C2 Link Security	6	L	M

Process Overview for the Requirements Mapping

The preliminary OSO classification was used as a starting point for mapping the standards from the standard collection. That means that, e.g., if a SC Light-UAS requirement was classified by EASA as OSO#4 and OSO#24, all standards that are applicable for OSO#4 and OSO#24 would also be checked for applicability to SC Light-UAS. Considering only this preliminary standard mapping, the combinations of standards that have to be mapped to requirements sum up to 878 combinations.

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However, for additional completeness, the keyword categorization that was introduced in the first iteration was also considered for finding additional standard mappings. Finally, text search was used for completing the mapping.

7. Status and Outlook

The collection of standards and the general data has been the first step of the work done. Currently there are more than 600 standards in the document. These standards were also categorized in the domains and subtopics to allow a first structuring.

SORA requirements were identified and large parts of the data were mapped against those requirements. Additionally, this approach was expanded to cover the currently available U-Space requirements based on the EASA opinion. The mapping of the standards towards these requirements is completed. It must be regarded that there are far less standards that are appropriate to be applicable to U-Space. Finally, the standard collection was augmented with the objective-based airworthiness requirements of SC Light-UAS.

The ongoing work is the inclusion of the WP4 assessment data into the data collection. When this is finished the next step will be to align the mapping that was the prior step to the assessment with the assessment results.

It is not appropriate to print here all pages of the data collection document. The complete Microsoft Excel version of the file is available online at this link.

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8. References

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[7] ANSI: Standardization Roadmap – For Unmanned Aircraft Systems, Version 1.0 (Available: https://www.surveymonkey.com/r/TJTGZS9)

[8] ASTM: Unmanned Aircraft Systems – A comprehensive solution (Available: https://www.astm.org/COMMIT/ASTM%20UAS%20Roadmap-1.pdf)

[9] AW-Drones: D2.1 Methodology for structuring of collected technical rules, standards and procedures – first release

[10] JARUS: Guidelines on Specific Operations Risk Assessment (SORA) – V2.0

[11] EASA: Opinion No 01/2020 - High-level regulatory framework for the U-space, 13.03.2020 (Available: https://www.easa.europa.eu/document-library/opinions/opinion-012020)

[12] EASA: Annex to EASA Opinion No 01/2020 - COMMISSION IMPLEMENTING REGULATION (EU) on a high-level regulatory framework for the U-space, (Available: https://www.easa.europa.eu/document-library/opinions/opinion-012020)

[13] EASA: Special Condition Light Unmanned Aircraft Systems - Medium Risk, Issue: 01, 17 December 2020, (Available: https://www.easa.europa.eu/document-library/product-certification-consultations/special-condition-light-uas)

Annex

Table 5: Domains and keywords used for categorization

Domains	Keywords Level 1	Keywords Level 2
General	Definitions	
	Classification of UAS operations	
	Classification of drones	
	Manuals	
Initial Airworthiness (at UAS level)	Flight performance	
	Limitations	
	Structures	
	Design & Construction	
	Propulsion	
	Electrical System	
	Noise & Environment	
	Level of Automation/Autonomy	
	Software Development Assurance	
	Airborne Electronic Hardware (AEH) Development Assurance	
	Remote Pilot Station	
	Systems safety assessment	
	Accident/Incident investigation	
	Systems & Equipment	Emergency capabilities & Health monitoring
		ATS Communication
		Detect and Avoid
		Navigation
		Lights
		Instruments
		Traffic surveillance (tracking)
		Command and Control (C2) Link
		Environmental qualification of Equipment (Ground and Airborne)
	Manuals	
	HMI	
	Human Factors	

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	Cyber-security	
	Organization	
	Electromagnetic Compatibility and Lightning Protection	
	Flight Control System	
	Fuel	
Continuing Airworthiness	Instructions for continued airworthiness	
	Manuals	
	Organization	
	Human Factors	
	UAS Maintenance personnel competence	
	Cyber-security	
	Maintenance & Inspection	
UAS Operations	Manuals	
	Organization	
	Level of Automation/Autonomy	
	Physical Security	
	Privacy and data protection	
	UAS Operator	
	C2 Link Service Provider	
	RPS Service Provider	
	Standard Scenarios	
	Accident/Incident investigation	
	Safety data collection and analysis	
	UAS-ATM (IFR above VLL and below FL 600)	
	Risk Assessment (Operations)	
	Human Factors	
	Take-off/Landing zones (urban vertiports)	
	Marking and Registration	
	E-Identification	
	U-Space Service Providers	
	Tracking	
	Geo-awareness	
	Cyber-security	
	HMI	
Aerodromes	Manuals	
	Organization	
	Level of Automation/Autonomy	
	Aerodrome operator	
	Take-off/Landing zones (urban vertiports)	
	Ground Handling Service	

U-Space/ATM	Manuals	
	Organization	
	Privacy and data protection	
	Level of Automation/Autonomy	
	C2 Link Service Provider	
	RPS Service Provider	
	Standard Scenarios	
	UAS-ATM (IFR above VLL and below FL 600)	
	Take-off/Landing zones (urban vertiports)	
	Ground Handling Service	
	Marking and Registration	
	E-Identification	
	U-Space Service Providers	
	Tracking	
	Geo-awareness	
	Cyber-security	
	HMI	
Environment	Aircraft Noise Emission	
	Aircraft gaseous emissions	
	Cumulative noise around vertiports	
Personnel	Manuals	
	Organization	
	Instructors	
	Examiners/Assessors	
	Training organizations	
	Human Factors	
	UAS Maintenance personnel competence	
	Remote Pilot competence	
	Additional crew members competence (non-regulated professions)	
Oversight	Manuals	
	Organization	
	UAS Operator	
	C2 Link Service Provider	
	RPS Service Provider	
	U-Space Service Providers	
	Notified bodies and Qualified Entities	

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