AW DRONES

Assessing drone standards against regulatory requirements

EASN Conference (Remote)

04th September 2020

This project has received funding from European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No°824292.

Outline

1. Methodology for assessment of standards
   - ➢ Assessment criteria
   - ➢ Assessment process
2. Verification of standard compliance with regulatory requirements
   - ➢ Overview of the mapping process
   - ➢ Example: Operational Safety Objectives #2
3. Current Results
4. Conclusions & Next Steps

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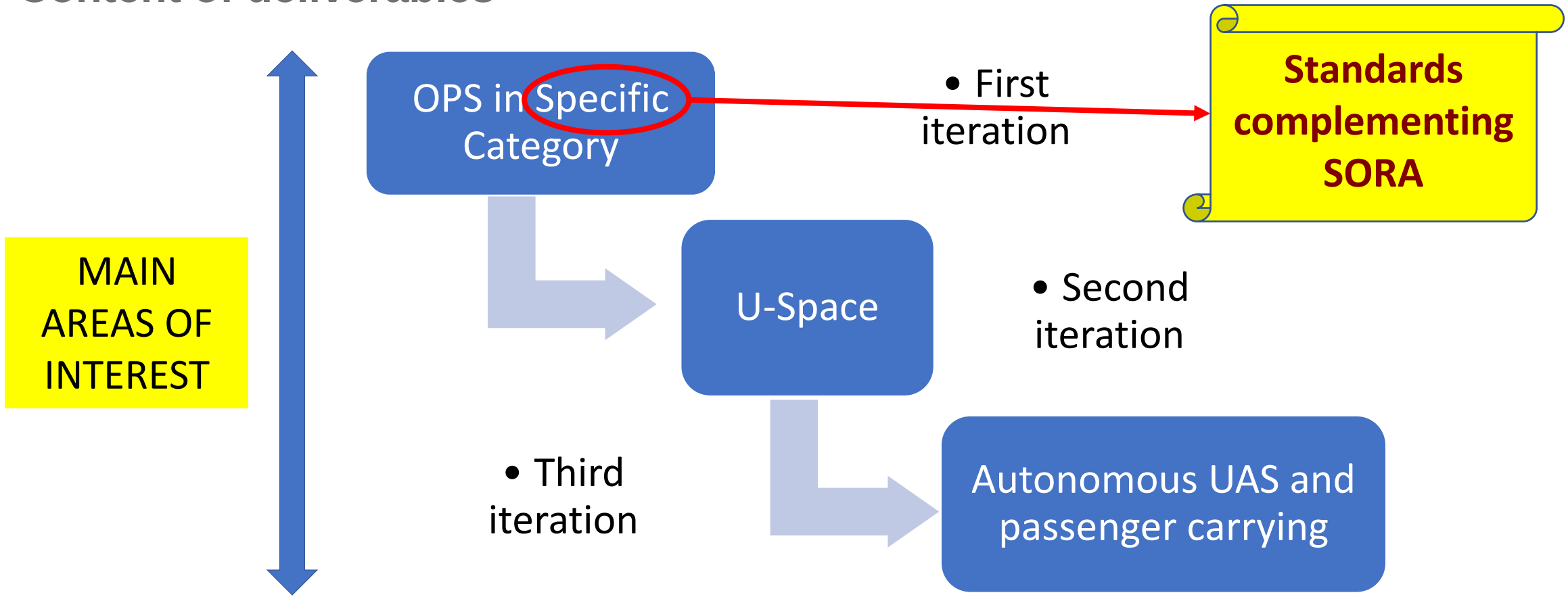
AW-Drones Iterations

Content of deliverables



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Methodology

- Methodology for assessment of standards comprises **three different cases:**

➢ CASE 1: Assessment of standards **potentially** suitable to comply with a certain SORA requirement (e.g. OSO #6)

➢ CASE 2: Assessment of gaps (i.e. SORA requirements not covered)

➢ CASE 3: Assessment of standards **not mappable** with any requirement ("orphan" standards)

- Multi Criteria Analysis addresses each **CASE**
- **CASES 1 and 2 completed for first iteration**
- CASE 3 not addressed in the first iteration

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Multi Criteria Analysis

- **Analytic method to compare and rank options**
- Allows to translate any assessment (qualitative or quantitative with different units of measurements) into **non-dimensional numerical scores … which can be algebraically summed**
- Scores may have different '**weight'**
- Allows to scope analysis considering **any relevant perspective**:

➢ **KPAs**

➢ **Environment**

➢ **Maturity**

➢ **Etc..**

Recommendations for Authorities/ Standard Making Bodies on the basis of the results (i.e. the weighted algebraic totals)

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CASE 1

- CASE 1: Assessment of standards **potentially** suitable to comply with a given SORA requirement

Criterion	Weight
Effectiveness to fulfill SORA requirement (e.g. OSO #6)	3
Maturity	1
Type of standard	1
Cost of compliance	2
Environmental impact	1
Impact on EU industry competitiveness	1
Social acceptance	1

Basic Scoring system

Criterion X	-2	-1	0	1	2

Weighted Score for each assessed standard:

Basic X Weight

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OSO #2 UAS manufactured by competent and/or proven entity

		Low	Medium	High
OSO #02 UAS manufactured by competent and/or proven entity	Criteria	As a minimum, manufacturing procedures cover: (a) the specification of materials; (b) the suitability and durability of materials used; and (c) the processes necessary to allow for repeatability in manufacturing, and conformity within acceptable tolerances.	Same as low. In addition, manufacturing procedures also cover: (a) configuration control; (b) the verification of incoming products, parts, materials, and equipment; (c) identification and traceability; (d) in-process and final inspections & testing; (e) the control and calibration of tools; (f) handling and storage; and (g) the control of non-conforming items.	Same as medium. In addition, the manufacturing procedures cover at least: (a) manufacturing processes; (b) personnel competence and qualifications; and (c) supplier control.
	Comments	*N/A*	*N/A*	*N/A*

TECHNICAL ISSUE WITH THE UAS		**Level of assurance**		
		Low	**Medium**	**High**
OSO #02 UAS manufactured by competent and/or proven entity	Criteria	The declared manufacturing procedures are developed to a standard considered adequate by the competent authority and/or in accordance with a means of compliance acceptable to that authority.	Same as low. In addition, evidence is available that the UAS has been manufactured in conformance to its design.	Same as medium. In addition: (a) manufacturing procedures; and (b) the conformity of the UAS to its design and specification are recurrently verified through process or product audits by a competent third party (or competent third parties).
	Comments	*N/A*	*N/A*	*N/A*

Design Organisation … but not approved by aviation authority

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OSO #2 UAS manufactured by competent and/or proven entity

Main standards assessed:

SDO	#	Title	Maturity
ASTM	F2911-14e1	Standard Practice for Production Acceptance of Small Unmanned Aircraft System (sUAS)	Published
ASTM	F3003-14	Standard Specification for Quality Assurance of a Small Unmanned Aircraft System (sUAS)	Published
ASTM	WK62731	New Practice for Compliance Audits to ASTM Standards on Unmanned Aircraft Systems	Planned
ASTM	F2972 - 15	Standard Specification for Light Sport Aircraft Manufacturer's Quality Assurance System	Published
ISO	9001:2015	Quality management systems — Requirements	Published
EN	9100:2018	QM system for manufacturers and service providers	Published

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OSO #2 UAS manufactured by competent and/or proven entity

Assessment of coverage:

Integrity/Assurance					
Criteria	**Robustness**	**Coverage**	**Recommended standard**	**Limitations/Notes**	**Score**
Criterion #1	Low	Partial	ASTM F3003-14 Standard Specification for Quality Assurance of a Small Unmanned Aircraft System (sUAS)	Only applicable to UAS with MTOM of less than 25 kg.	3
		Partial	ASTM F2911-14e1 Standard Practice for Production Acceptance of Small Unmanned Aircraft System (sUAS)	Only applicable to UAS with MTOM of less than 25 kg developed according to ASMT F2910.	3
		Full	ASTM F2972 - 15 Standard Specification for Light Sport Aircraft Manufacturer's Quality Assurance System	No specific requirements related to UAS manufacturing procedures.	7
		Full	ISO 9001:2015 Quality management systems - Requirements	Only high level guidance. No specific requirements related to UAS manufacturing procedures.	**13**
		Full	EN 9100:2018 Quality Management Systems - Requirements for Aviation, Space and Defence Organizations	No specific requirements related to manufacturing procedures for UAS	**11**

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OSO #2 UAS manufactured by competent and/or proven entity

Assessment of coverage:

Integrity/Assurance					
Criteria	**Robustness**	**Coverage**	**Recommended standard**	**Limitations/Notes**	**Score**
Criterion #1	Medium	Partial	ASTM F3003-14 Standard Specification for Quality Assurance of a Small Unmanned Aircraft System (sUAS)	Only applicable to UAS with MTOM of less than 25 kg.	5
		Partial	ASTM F2911-14e1 Standard Practice for Production Acceptance of Small Unmanned Aircraft System (sUAS)	Only applicable to UAS with MTOM of less than 25 kg developed according to ASMT F2910.	5
		Full	ASTM F2972 - 15 Standard Specification for Light Sport Aircraft Manufacturer's Quality Assurance System	No specific requirements related to UAS manufacturing procedures.	**11**
		Full	ISO 9001:2015 Quality management systems - Requirements	Only high level guidance. No specific requirements related to UAS manufacturing procedures.	**15**
		Full	EN 9100:2018 Quality Management Systems - Requirements for Aviation, Space and Defence Organizations	No specific requirements related to manufacturing procedures x UAS	**13**

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OSO #2 UAS manufactured by competent and/or proven entity

Gap Identification

- Gaps are identified at both Integrity and Assurance level (i.e requirements **partially covered** or **not covered at all** by available standards)

	Low	Medium	High
Integrity	Absence of standards addressing specifically UAS manufacturing processes and quality assurance, that are applicable for any UAS		
	Low	**Medium**	**High**
Assurance	Not applicable	No gaps identified	No gaps identified

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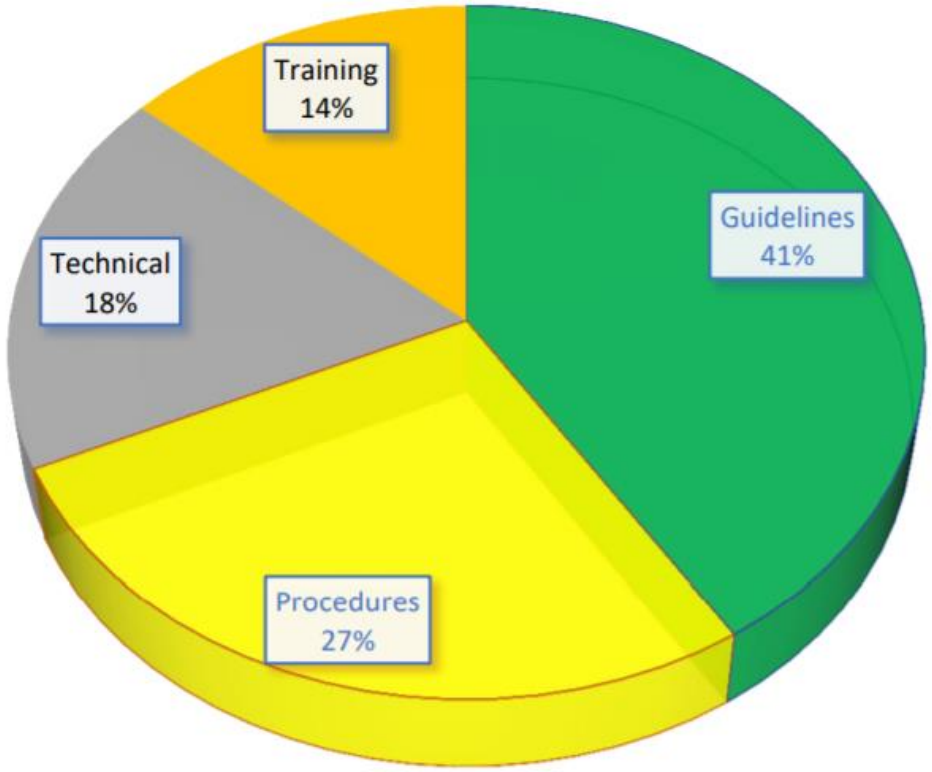
Current results

- **All** SORA requirements are at least partially covered by existing standards
- **Less than a quarter** of requirements are fully covered by existing standards
- **44 Gaps** identified
- Most gaps identified lead to the **recommendation to develop new standards/guidelines** or integrate existing ones



Overview of Gaps

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Conclusions and Next Steps

- **Mapping with SORA requirements**:
  - Identified a set of standards covering SORA requirements
  - Main gaps highlighted

- **Next Steps**:
  - **Report gaps to EC/EASA and EUSCG (comprising several SDOs) for confirmation of gap and possible action (AW DRONES is not SDO)**
  - **Report results of assessment to EASA as candidate AMCs**
  - Re-iterate results over the course of the whole project
  - Assessment of U-Space requirements and related mapped standards
    - Current focus on e-identification and geo-awareness

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Thanks for your attention !

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Back-up slides

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OSO #2 UAS manufactured by competent and/or proven entity

	Low	Medium	High
Integrity / Assurance	Partial	Partial	N.A.

F2911-14e1

Standard Practice for Production Acceptance of Small Unmanned Aircraft System (sUAS)

Status: Published

Remarks:

- This standard defines the production acceptance requirements for a small unmanned aircraft system (sUAS).
- This standard is applicable to sUAS that comply with design, construction, and test requirements identified in Specification F2910.

Gaps:

The standard is only applicable to UAS with MTOM less than 25 kg manufactured according to the Specifications identified in ASTM F2910

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OSO #2 UAS manufactured by competent and/or proven entity

Multi criteria analysis (MCA):
ASTM F2911-14e1 – Low Robustness

Total score: +3

Maturity: Published

Type: Best practice

Effectiveness: Partial

Cost of compliance: High

The documents mentions that the manufacturer must have a configuration management, a product specific and a product verification, and a test plan, among others. These may imply expensive processes, especially to reach Low Robustness integrity.

Environmental Impact: Neutral

Impact on EU Industry: Positive

The document establishes the requirements for product acceptance having a positive impact in clarifying requirements for EU manufacturers of certifiable technologies.

Social Acceptance: Positive

The adoption of a standard which reinforces safety policies is seen favourably by the public.

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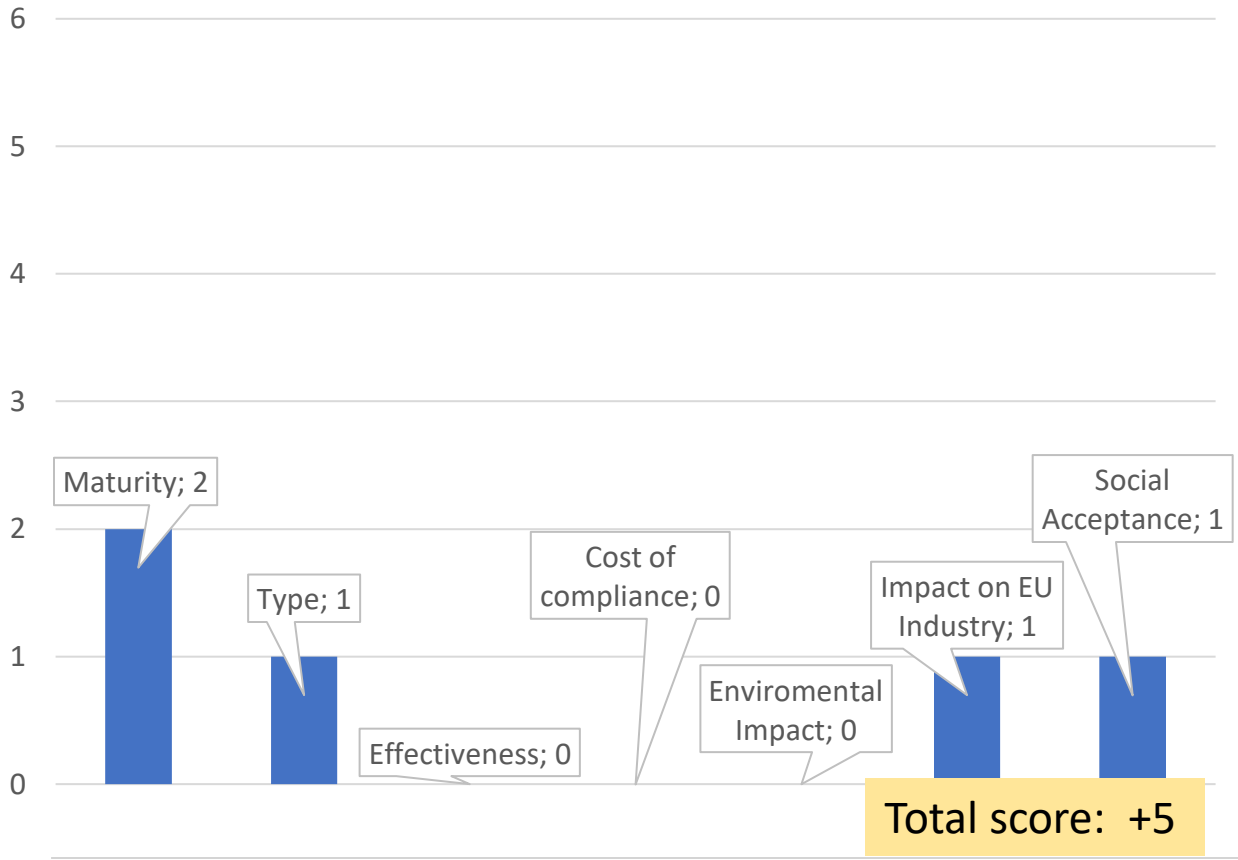
OSO #2 UAS manufactured by competent and/or proven entity

Multi criteria analysis (MCA):
ASTM F2911-14e1 – Medium Robustness



Maturity: Published

Type: Best practice

Effectiveness: Partial

Cost of compliance: Medium

The documents mentions that the manufacturer must have a configuration management, a product specific and a product verification, and a test plan, among others. These processes are expected to be in line with the required level of integrity at medium robustness.

Environmental Impact: Neutral

Impact on EU Industry: Positive

The document establishes the requirements for product acceptance having a positive impact in clarifying requirements for EU manufacturers of certifiable technologies.

Social Acceptance: Positive

The adoption of a standard which reinforces safety policies is seen favourably by the public.

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OSO #2 UAS manufactured by competent and/or proven entity

Gap assessment: Criteria and scoring system

Criterion (Weight)	-2	-1	0	1	2
Safety (3)	Very High	High	Medium	Low	Very Low
Cost of compliance (2)	Very High	High	Medium	Low	Very Low
Environmental Impact (1)	Bad	N.A.	Neutral	N.A.	Good
Impact on EU Industry competitiveness (1)	Very negative	Negative	No impact	Positive	Very positive
Social Acceptance (1)	Very negative	Negative	No impact	Positive	Very positive

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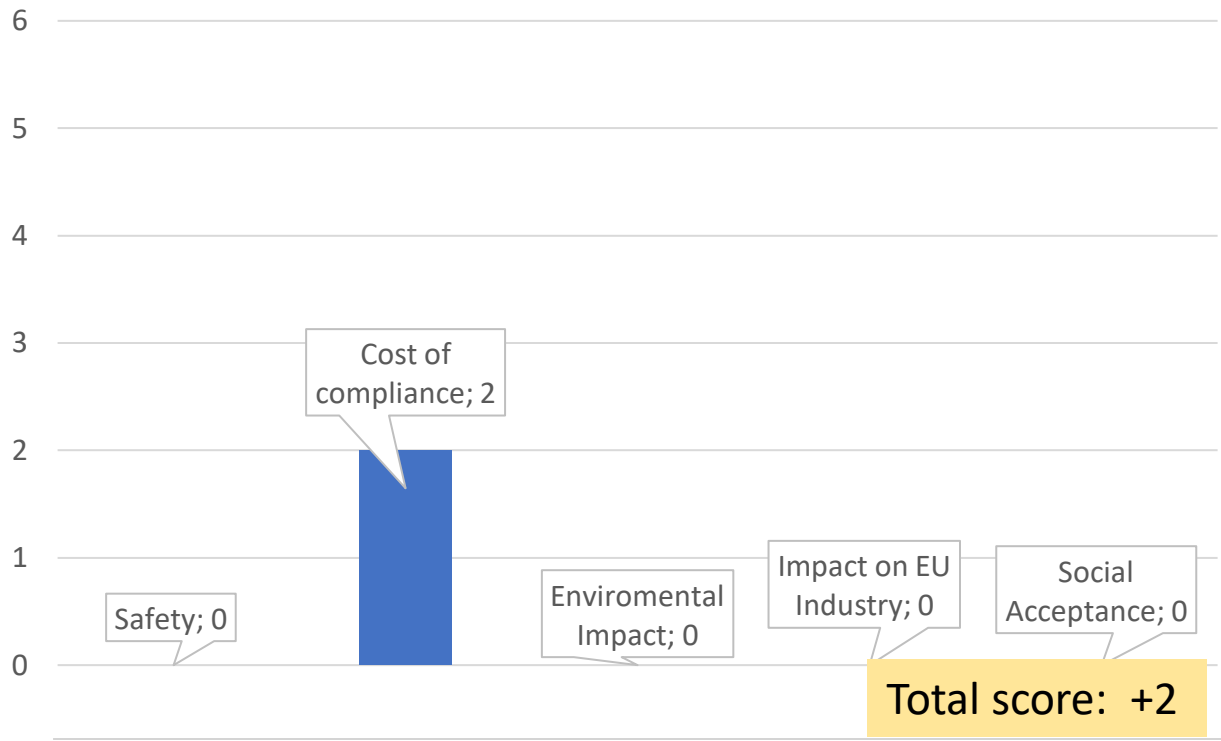
OSO #2: Gaps

Multi criteria analysis (MCA):

Absence of standards addressing specifically UAS manufacturing processes and quality assurance, that are applicable for any UAS



Impact on Safety: (Medium)

- The absence of a specific standard might not be critical if this is compensated by the implementation of an adequate generic quality management system according to one of the available standards (e.g. ISO 9001 or EN 9100)

Cost of compliance: (Low)

- The cost of compliance to the requirements of OSO #2 in absence of a specific standard is estimated as low, given that the manufacturer will likely implement in any case a quality management system for commercial reasons.

Environmental Impact: (Neutral)

Impact on EU Industry: (No Impact)

Social Acceptance: (No Impact)

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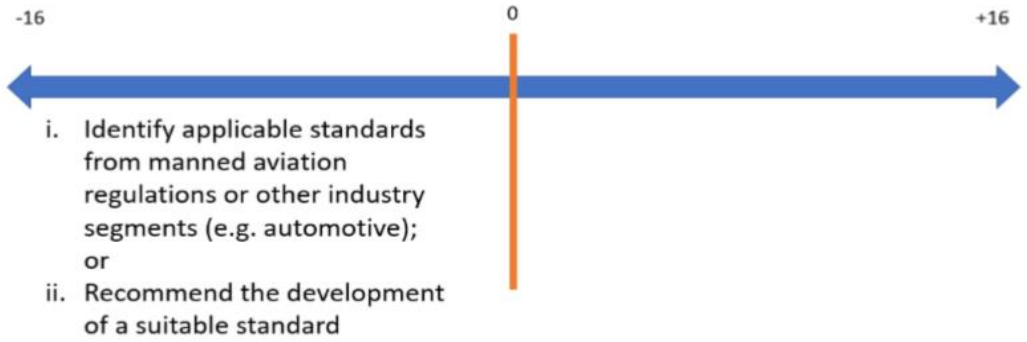
OSO #2 UAS manufactured by competent and/or proven entity

Gap assessment: Final Recommendations



Gap description	Total weighted score	Recommendations
Absence of standards addressing specifically UAS manufacturing processes and quality assurance, that are applicable for any UAS.	+2	The development of a dedicated standard might not be needed, but manufacturers should at least implement a quality management system compliant with ISO 9001 or (ASTM F3003-14 for small UAS), which is compliant with the requirements defined by OSO #2 at the required level of integrity

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Mapping Example #1

	Low	Medium	High
Integrity / Assurance	Partial	Partial	Partial

F3003-14

Standard Specification for Quality Assurance of a Small Unmanned Aircraft System (sUAS)

Status: Published

Remarks:

- This specification establishes the quality assurance requirements for the design, manufacture, and production of a small unmanned aircraft system (sUAS). It is intended for all sUAS that are permitted to operate over a defined area and in airspace defined by a nation's governing aviation authority (GAA). Unless otherwise specified by a nation's GAA, this specification applies only to UA that have a maximum take-off gross weight of 55 lb/25 kg or less.
- This standard defines the quality assurance requirements for the design, manufacture, and production of a small unmanned aircraft system (sUAS).

Gaps:

It is only applicable for UAS with MTOM of less than 25 kg.

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	Low	Medium	High
Integrity	N/A	N/A	Full
Assurance			

WK62731

New Practice for Compliance Audits to ASTM Standards on Unmanned Aircraft Systems

Status: Planned

Remarks:

- This practice establishes the minimum set of requirements for auditing programs, methods, and systems; the responsibilities for all parties involved; and qualifications for entities conducting audits against ASTM International standards on unmanned aircraft systems (UAS).
- This practice provides requirements to enable consistent and structured examination of objective evidence for compliance that is beneficial for the UAS industry and its consumers. It is the intent of this practice to provide the necessary minimum requirements for organizations to develop audit programs and procedures.

Gaps:

It is understood that the standard may be useful for internal quality control in design and production, although the standard is only planned

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	Low	Medium	High
Integrity	Full	Full	Full
Assurance			

F2972 - 15

Standard Specification for Light Sport Aircraft Manufacturer's Quality Assurance System

Status: Published

Remarks:

- This specification establishes the minimum requirements for a quality assurance system for manufacturers of Light Sport Aircraft or Light Sport Aircraft kits, or both. Therefore, it is not specific for UAS.

Gaps:

No specific requirements related to UAS manufacturing procedures.

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	Low	Medium	High
Integrity	Partial	Partial	Partial
Assurance			

ISO 9001:2015 Quality management systems — Requirements

Status: Published

Remarks:

- The standard is generically defining how to establish a quality management system but there are no details on how to do such thing for the manufacturing of UAS. Nevertheless, a quality system compliant with this standard is a valid starting point to demonstrate compliance to OSO #2.

Gaps:

The standard is generically defining how to establish a quality management system but there are no details on how to do such thing for the manufacturing of UAS.

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	Low	Medium	High
Integrity	Full	Full	Full
Assurance			

EN 9100:2018

Quality Management Systems - Requirements for Aviation, Space and Defence Organizations

Status: Published

Remarks:

- This standard is intended for the specific implementation of the ISO 9001 standards in the aerospace industry. Nevertheless, a quality system compliant with this standard is considered sufficient to demonstrate compliance to OSO #2 at all levels of robustness.

Gaps:

- The standard is generically defining how to establish a quality management system but there are no details on how to do such thing for the manufacturing of UAS

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Gap analysis (F=Full, P=Partial, N=No coverage)

GRC Mitigations	Coverage
M1	P
M2	P
M3	P

Tactical Mitigations	Coverage
VLOS	N
BVLOS	F

Adj airsp./area	Coverage
Adj. airspace req.	F

OSO	Coverage	OSO #	Coverage
# 1	P	# 10/12	F
# 2	P	# 13	P
# 3	F	# 16	P
# 4	P	# 17	N
# 5	P	# 18	P
#6	F	# 19	P
# 7	F	# 20	P
# 8/11/14/21	F	# 23	P
# 9/15/22	F	# 24	F

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