Regulation and Risk Assessment for Drone Operations

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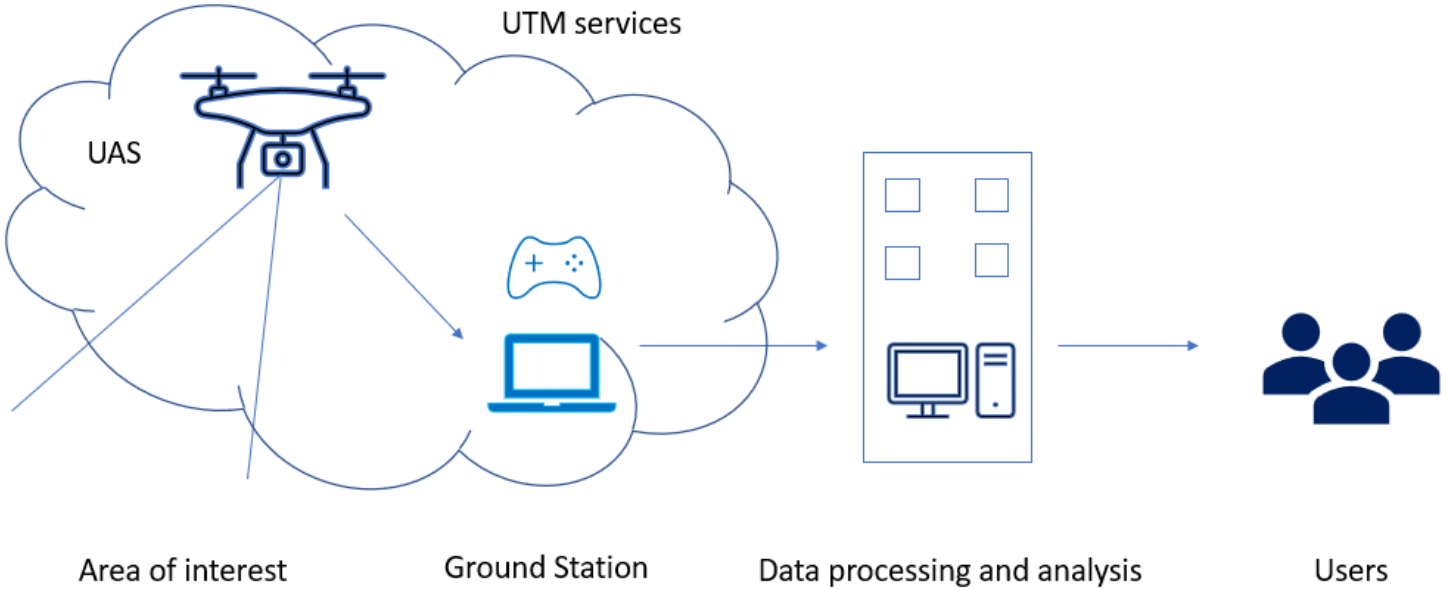
Outline

- Introduction
- Drone Regulation
- Risk Assessment
- Operative Examples
- References

Introduction

Strategical phase

Tactical phase



Drone Regulation

Regulation (EU) 2019/947: definition of three categories and need of operational risk assessment

- Open category → No declaration or authorization is required
- Specific Category → Declaration (lower risk) or Authorization request (higher risk)

SORA

PreDefined Risk Assessment
5 PDRA

Standard Scenarios
STS01 - STS02

Drone regulation

1. Open Category
2. Specific Category
3. Certified Category

Parameters involved in Risk Assessment:

- Operative environment
- Air vehicle and equipment
- Mission objective

+ Applicable mitigations = Final risk

Risk Assessment

Specific Operations Risk Assessment (SORA), version 2.0

SAIL - Specific Assurance and Integrity Level:

- Low Risk → SAIL I and II (Standard Scenarios STS01, STS02)
- Medium Risk → SAIL III and IV
- High Risk → Sail V and VI
- Otherwise→ Certified Category

Safety: procedures and equipment

Security: procedures and equipment

risk reduction - unintentional accidents

risk reduction - intentional actions

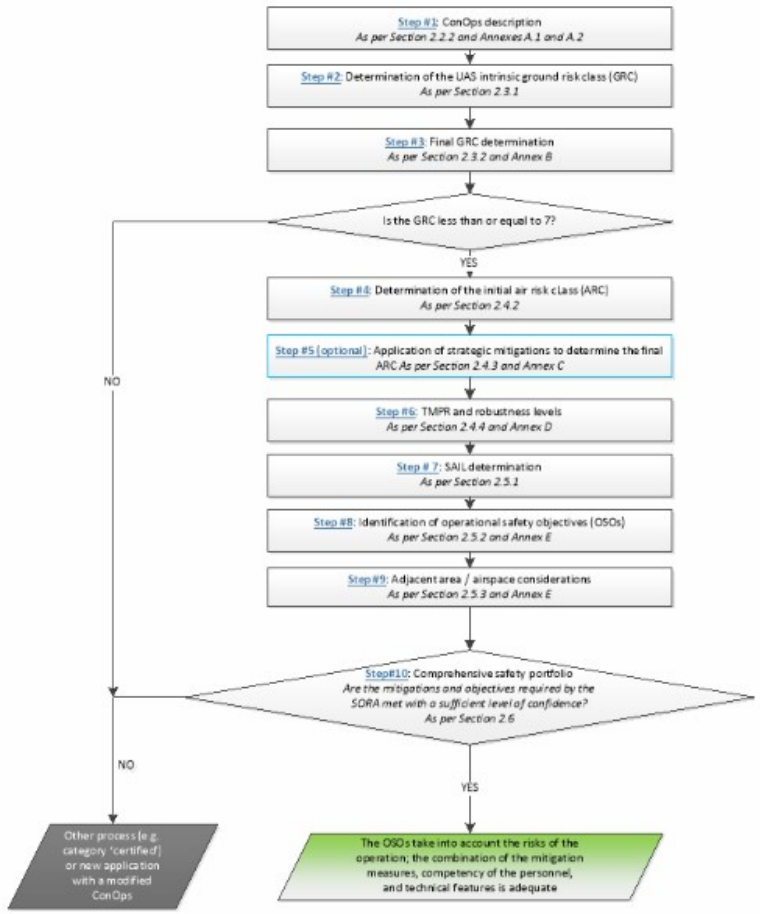
Risk Assessment

COVER REGULATION TO IMPLEMENTING REGULATION (EU) 2019/947

AMC1 ARTICLE 11 RULES FOR CONDUCTING AN OPERATIONAL RISK ASSESSMENT

HTTPS://WWW.EASA.EUROPA.EU/EN/DOCUMENT-LIBRARY/EASY-ACCESS-RULES/ONLINE-PUBLICATIONS/EASY-ACCESS-RULES-UNMANNED-AIRCRAFT-SYSTEMS?PAGE=4

Joint Authorities for Rulemaking on Unmanned Systems



Risk Assessment

Step #0 – Preliminary Considerations. According to Regulation (EU) 2019/945, 2019/947, 2020/1058 check if the operation is within Specific category

! authority can evaluate if stricter rules must be applied.

Step #1 – CONOPS description

Step #2 – Initial Ground Risk Class (GRC) determination

Intrinsic UAS Ground Risk Class				
Max UAS Characteristics dimension	1m	3m	8m	>8m
Typical kinetic energy expected	<700J	<34kJ	<1084kJ	>1084kJ
Operational scenarios				
VLOS/BLOS over controlled ground area	1	2	3	4
VLOS in sparsely populated environment	2	3	4	5
BVLOS in sparsely populated environment	3	4	5	6
VLOS in populated environment	4	5	6	8
BVLOS in populated environment	5	6	8	10
VLOS over gathering of people	7			
BVLOS over gathering of people	8			

AMC1 Article 11 Rules for conducting an operational risk assessment

https://www.easa.europa.eu/en/document-library/easy-access-rules/online-publications/easy-access-rules-unmanned-aircraft-systems?page=4

Risk Assessment

Step #3 – Final GRC determination with mitigations (parameter to sum/subtract)

1. M1 – Strategic mitigations for ground risk (e.g. risk buffer, tethered operation)
2. M2 – Evaluation to reduce the effects of a ground impact (e.g. parachute)
3. M3 – Evaluation and effectiveness of an Emergency Response Plan (ERP).

Step #4 – Initial Air Risk Class (ARC) determination

Step #5 – Strategic mitigations to reduce initial ARC (e.g. exposure time, NOTAM, cooperative systems)

AMC1 ARTICLE 11 RULES FOR CONDUCTING AN OPERATIONAL RISK ASSESSMENT

https://www.easa.europa.eu/en/document-library/easy-access-rules/online-publications/easy-access-rules-unmanned-aircraft-systems?page=4

Risk Assessment

Step #6 – Tactical Mitigation Performance Requirements and robustness level (e.g. VLOS, recognised Detect And Avoid system standards, TCAS,…)

Step #7 – SAIL (Specific Assurance and Integrity Level) determination

Step #8 – Operational Safety Objectives determination (24)

Step #9 – Adjacent Area/Airspace Considerations

Step #10 Comprehensive Safety Portfolio

SAIL determination

	Residual ARC			
Final GRC	**a**	**b**	**c**	**d**
≤2	I	II	IV	VI
3	II	II	IV	VI
4	III	III	IV	VI
5	IV	IV	IV	VI
6	V	V	V	VI
7	VI	VI	VI	VI
>7	Category C operation			

AMC1 Article 11 Rules for conducting an operational risk assessment

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Risk Assessment

Source: SORA version 2.5 → Main changes

1. GRC definition and mitigations
2. Adjacent Area Lateral Distance Calculation (no air risk buffer, but adjecent area limits, 3 minutes at max cruise speed)
3. Cybersecurity considerations
4. Containment Requirements definition at Step #8
5. OSO at Step #9 with improvements

AMC1 ARTICLE 11 RULES FOR CONDUCTING AN OPERATIONAL RISK ASSESSMENT

https://www.easa.europa.eu/en/document-library/easy-access-rules/online-publications/easy-access-rules-unmanned-aircraft-systems?page=4

Risk Assessment

Ground Risk Class

"Global Human Settlement Layer" of the European Union for population density

Mitigations:

- M1(A): Strategic mitigation for ground risk (e.g. shelter)
- M1(B): VLOS, no overflight of people (e.g. change path to protect people)
- M2: Reduction of effects of drone impact dynamics (technical)
- ~~M3~~

Intrinsic UAS Ground Risk Class						
Max UAS Characteristics dimension		1m	3m	8m	20m	40m
Max cruise speed		25m/s	35m/s	75m/s	150m/s	200m/s
Max iGRC population density (ppl/km2)	Controlled ground area	1	2	3	4	5
	<25	3	4	5	6	7
	<250	4	5	6	7	8
	<2.500	5	6	7	8	9
	<25.000	6	7	8	9	10
	<250.000	7	8	9	10	11
	>250.000	9	9	Category C		

Risk Assessment

PreDefined Risk Assessment (PDRA), AMC to Article 11 Regulation (EU) 2019/947

- PDRA S01 – Agricultural works, short range goods transport missions
- PDRA S02 – Surveillance, agricultural works, short range goods transport missions
- PDRA G01 – Surveillance, long range goods transport missions
- PDRA G02 – All range PDRA G03, **inspections**, agricultural works
- PDRA G03 – **Inspections**, agricultural works

…other PDRA operations under consideration…

Risk Assessment

Examples of PDRAs

PDRA	UAS Characteristics	Main features	Examples of operations
PDRA-S01 AMC4 Article 11	Max dimension 3m	•VLOS; •Controlled ground area also over populated area; •Controlled or uncontrolled airspace less than 150m AGL;	Agricultural works, short range cargo ops
PDRA-G03 AMC6 Article 11	Max dimension 3m	•BVLOS; •Over sparsely populated area; •Controlled or uncontrolled airspace close to obstacles as defined in the PDRA	Linear inspections, agricultural works

Operative Examples

Example 1 ➡ EASA, Opinion No 05-2019

Standard scenarios for UAS operations in the “specific” category

STS01

- VLOS
- Max operative height below 120m also urban environment
- C5 drone (otherwise PDRA S01)
- No involved people in the controlled ground area
- Airspace with low risk of manned aircraft collisions
- Pilot training A1/A3, A2, STS

Operative Examples

Example 1 ➡ EASA, Opinion No 05-2019

STS01

VLOS with C5 drone over a controlled area
MTOM up to 25 kg and max characteristics <3m

! in the table 2 is the minimum number

M1 = 0 (none)
M2 = 0 (low)
M3 = 0 (medium)

GRC = 2

Intrinsic UAS Ground Risk Class				
Max UAS Characteristics dimension	1m	3m	8m	>8m
Typical kinetic energy expected	<700J	<34kJ	<1084kJ	>1084kJ
Operational scenarios				
VLOS/BLOS over controlled ground area	1	2	3	4
VLOS in sparsely populated environment	2	3	4	5
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VLOS in populated environment	4	5	6	8
BVLOS in populated environment	5	6	8	10
VLOS over gathering of people	7			
BVLOS over gathering of people	8			

Mitigation	Low/None	Medium	High
M1	-1/0	-2	-4
M2	0	-1	-2
M3	1	0	-1

Operative Examples

Example 1 ➡ EASA, Opinion No 05-2019

STS01

Highest residual ARC = ARCb
Low probability for collisions with manned aircraft

SAIL = II

Check OSO compliant (e.g. operator skills, drone maintenance, crew training…)

SAIL determination				
	Residual ARC			
Final GRC	**a**	**b**	**c**	**d**
≤2	I	II	IV	VI
3	II	II	IV	VI
4	III	III	IV	VI
5	IV	IV	IV	VI
6	V	V	V	VI
7	VI	VI	VI	VI
>7	Category C operation			

Operative Examples

Example 2 ➡ EASA, Explanatory Note to Decision 2022/002/R

PDRA-G03 (Linear inspection)

- Drone: Max dimension 3m
- Rule: BVLOS
- Ground environment: sparsely populated area
- Air environment: Controlled or uncontrolled airspace close to obstacles as defined in the PDRA (e.g. 15m above obstacle, max height according to the requested volume <30m,…)

Operative Examples

Example 2 ➡ EASA
Explanatory Note to Decision 2022/002/R

PDRA-G03

Intrinsic GRC = 4

! in the table 2 is the minimum number

Final GRC = 3

Intrinsic UAS Ground Risk Class				
Max UAS Characteristics dimension	1m	3m	8m	>8m
Typical kinetic energy expected	<700J	<34kJ	<1084kJ	>1084kJ
Operational scenarios				
VLOS/BLOS over controlled ground area	1	2	3	4
VLOS in sparsely populated environment	2	3	4	5
BVLOS in sparsely populated environment	3	4	5	6
VLOS in populated environment	4	5	6	8
BVLOS in populated environment	5	6	8	10
VLOS over gathering of people	7			
BVLOS over gathering of people	8			

Mitigation	Low/None	Medium	High
M1	-1/0	-2	-4
M2	0	-1	-2
M3	1	0	-1

Operative Examples

Example 2 ➡ EASA
Explanatory Note to Decision 2022/002/R

PDRA-G03

- Residual ARCa
- SAIL II
- Self Declarations/Declarations with data

(e.g. no autonomous flight, direct C2 link, ground and air risk buffer, drone maintenance…)

SAIL determination				
	Residual ARC			
Final GRC	**a**	**b**	**c**	**d**
≤2	I	II	IV	VI
3	II	II	IV	VI
4	III	III	IV	VI
5	IV	IV	IV	VI
6	V	V	V	VI
7	VI	VI	VI	VI
>7	Category C operation			

UAS Activities

Laboratory for Innovative Flight Technology (LIFT) at CeSMA
(Università degli Studi di Napoli Federico II)

- Test laboratory for innovative aerospace systems technologies
- Laboratory dedicated to technology transfer
- Support activities for critical operations with drones
- Availability of netted area with GNSS and 5G signal coverage
  Availability of open spaces for outdoor tests in Castel Volturno
- ENAC accreditation as drone operator - CeSMA LIFT

Sustainable Air Mobility

Centro Nazionale per la Mobilità Sostenibile
Spoke 1

Several topics to reduce the environmental impact…

➡ Urban Air Mobility and Advanced Air Mobility

Development of more efficient and sustainable configurations for on-board systems design of different aircraft types: unmanned eVTOL, general aviation, regional aircraft.

https://www.centronazionalemost.it/
“C. Conte, D. Accardo, Improvements in on-board systems design for advanced sustainable air mobility, XXVII A.I.D.A.A. International Congress 2023, Padova, Italy”

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