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5 services of Drones for increased airports and waterways safety and security

User Workshop and Report

Document Summary Information

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Responsible Author	Evangelos Markakis, Yannis Nikoloudakis		
Contributions from	Nikos Astyrakakis		

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V.1	5/11/2020	First draft	Table of Contents	Yannis Nikoloudakis	Chapter titles were defined
V.2	16/11/2020	Pre-Release	Review by QAM	Anna Nikodym-Bilska	Final review before the submission

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Executive Summary

The purpose and scope of this deliverable is to provide a detailed report on the user workshop that took place on the 3rd of November 2020, M6 of the project's lifecycle. The first workshop of the 5D-AeroSafe project, with the purpose of collecting insights and directions from experts, involved in U-Space projects (e.g. EUROCONTROL, EASA, SESAR JU, etc.), the industry (e.g. Thales, Airbus, etc.), as well as end users, and gather user and operational requirements, as well as barriers and possible obstacles, based on their insights and their expertise in the field. The outcomes of this document will act as a direct input for WP2 of the project.

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Glossary of terms and abbreviations used

Abbreviation / Term	**Description**
ATZ	Aerodrome Traffic Zones
NOTAM	Notice to Airmen
UTM	Unmanned Aircraft Traffic Management System
ATM	Air Traffic Management
ATC	Air Traffic Control
CONOPS	Concept of Operations
UAV	Unmanned Aerial Vehicle
VOR	VHF Omnidirectional Range
DME	Distance Measuring Equipment
NAVAIDS	Navigational Aids
GDPR	General Data Protection Regulation
UAS	Unmanned Aircraft System
CNS	Communications, Navigations & Surveillance
STO	Scientific and Technical Objectives
ICAO	International Civil Aviation Organization
FAA	Federal Aviation Administration
FOD	Foreign Object Debris
FMCW	Frequency-Modulated Continuous Wave radar

1 Introduction

Within the 5D-AeroSafe project, we will investigate the utilization of Unmanned Aerial Vehicles (UAVs) for the calibration of equipment (CNS/GNSS), inspection of aircrafts, runways and taxiways, waterways' operations and security checks in airports' perimeter. These procedures, especially within critical infrastructures such as airports, raise several ethical and legal concerns, in terms of lawful and regulations-abiding operations of UAVs. To address this complex issue as early as possible, the consortium has compiled an advisory board, comprising experts in the field and researchers already involved in similar EU-funded projects, to provide their insight and expertise in crucial matters such as regulations legislations, best practices and potential barriers.

Moreover, the consortium organised the first project's workshop, to initiate discussions and allow the exchange of knowledge and experience, to validate the existing requirements, and possibly extract new functional, non-functional, and/or user requirements. The purpose and scope of this deliverable is to report the proceedings and the outcomes of the afore-mentioned workshop. Ultimately, the results and outcomes of this workshop will act as a direct input for WP2, for the definition of concept of operations and the governing regulatory framework throughout the project's lifecycle.

The rest of this document is structured as follows. In Section 2 we present the agenda of the workshop, and the context for each session. In Section 0, we present the participants of the workshop and their relevance to the project. In Section 4, we present the respective questions that were compiled for the purposes of this workshop, to help initiate discussions. In Section 5 we discuss the workshop objectives and outcomes and its overall contribution to the project. Finally, in Section 6 we conclude this report by summarizing the results of this workshop.

2 Workshop Agenda

The workshop started at 09.30 (UTC +2) with a welcome message from Dr. Evangelos Markakis of Hellenic Mediterranean University, and a roundtable and presentation of every partner. Then, Mr. Philippe Chrobocinski (Project Coordinator) from AIRBUS made a short presentation of the whole project.

Following, in the first session (10:00 - 12:00), Ms. Effie Makri from FINT , introduced the speakers of the first 5D-AeroSafe workshop, who respectively presented their part in Concept of Operations (CONOPS), including an analysis of U-SPACE guidelines/regulations and held a discussion on the findings.

Furthermore, Mr. Carlos del Río from FERROVIAL presented a list of airport environment considerations and recommendations concerning Unmanned Aerial Vehicle (UAV) operations. The key points of his presentation were the main challenges in airports, the advantages and the disadvantages within airport environments, the Aerodrome Traffic Zones (ATZ), the Notice to Airmen (NOTAM) and the UAV flight height regulations.

Additionally, the presenter defined three UAV operation categories. Segregated, coordinated and integrated categories that depend on Air Traffic Control (ATC), unmanned and manned aircraft operations. Finally, the presenter defined some prerequisites for UAVs that should be considered, such as acceptable equipment, giving priority to manned aircraft, etc. Moreover, he shared some previous experience with other UAV-like applications, and provided some useful information about UAV fly zones, standard buffers, risk mitigation and safety, and security assessment in critical infrastructures.

The presentation of Mr. Carlos del Rio raised some questions from Mr Gonzalo Velasco, Business Plan and Innovation Director from FERROVIAL, concerning the reliability of UAVs in certain weather conditions. Additionally, he recommended that we cannot fully rely on UAVs, thus backup plans should always be considered.

In the second session, Mr. Yannick Jestin from ENAC presented the current regulatory framework concerning UAV operations, and the future requirements of the project. Specifically, he presented the regulatory framework for all project's Trials respectively (Trial A - Navaids Inspection, Trial C - Heathrow and Trial D - Increased Airport and Waterway Safety and Security). His input was that all UAVs should firstly follow the manned aircraft regulations, and consequently follow the Unmanned Aircraft System (UAS) regulations. Additionally, he presented the envisioned procedures for the smooth integration of Unmanned Aircraft System (UAS) with Unmanned Aircraft Traffic Management System (UTM) and Air Traffic Management systems (ATM), abiding by the current ICAO Regulations.

Furthermore, one additional presentation was performed by Mr. Yannick Jestin from ENAC, with the help of Mr. George Nikolouzos from Water Airports of Greece, Mr. Carlos Del Rio from FERROVIAL and Mr. Marinos Kardaris from FINT, wherein they presented the project's use cases. Firstly, they presented the use case design process, the design scenarios of UAVs and the considerations for unexpected events. The list of use cases was categorized based on the trials, and each category was further analysed. The first category, trial A, described the use cases concerning Navigational Aids (NAVAIDs), users, technologies and scientific and technical objectives (STOs). The presenter described the VHF Omnidirectional Range (VOR) Ground NAVAIDs in long/short distance, the performance testing of Distance Measuring Equipment (DME), VOR inspection missions and DME evaluation missions. Next, concerning Trial C (Heathrow Airport - UK), they described the importance of safety precautions in airport operations, the complex environments' situations, the inspection procedures, the scenarios description, the users, the STOs, the technologies and the locations of the airport, where these operations will take place. Finally, concerning Trial D (Corfu - Greece), they presented the waterdrome use case objectives, work scenarios, user requirements, STOs and scenarios' description.

Moreover, Mr. Carlos del Rio (FERROVIAL) informed participants about a Frequency-Modulated Continuous Wave (FMCW) radar for foreign object debris (FOD) detection, which is already installed in Heathrow airport. This millimetre radar sets a new requirement for mandatory inspections from UAVs. Additionally, inspection operations, by autonomous UAVs, in the case of FMCW radar object detection, should be performed quicker compared to vehicles and UAV remote pilots (people controlling UAVs). Additionally, he commented on the inspections from UAVs concerning the buildings' rooftops, the level 2 routine inspections, as well as the inspection of some areas far from the ATC tower.

Moreover, Mr. Gonzalo Velasco made a comment concerning the resources required to perform data processing, and upon the consideration of manual versus automatic data analysis. Jannick Jestin (ENAC) replied that visual analysis is part of the project, and data processing must be as fast as possible. Additionally, he identified that data processing depends on the bandwidth of the link and the frequency/time of object detection. Finally, Mr. Marinos Kardaris (FINT) proposed the development of a miniaturized test transceiver, to minimize procedures for Communications, Navigations & Surveillance (CNS) Inspections.

The presentation of Mr. Jannick Jestin (ENAC) ended with Mr. Gonzalo Velasco's final question, concerning the location where the processing will be performed, meaning whether they will be performed on the UAV, or on a remote server. Mr. Jannick Jestin (ENAC) replied that this issue will be exhaustively discussed in the technical work packages and expressed the opinion that processing should probably not be performed on the UAV. Additionally, Mr. Philippe Chrobocinski (Project Coordinator) commented that we need to define the level of required automation, which will help us avoid mistakes.

In the last season (12.30-13.00) of the workshop there was a discussion between the participants about some key questions. Dr. Evangelos Markakis (HMU) posed a question, about the existence of regulations concerning the weather conditions with which UAVs can operate. It was answered by Mr. Jannick Jestin (ENAC), replied that the answer is not feasible at the moment, and that the conditions depend on the scenario. Another question was posed by Mr. Robert Geister about the possible ethical and legal considerations and issues, concerning waterways and land ownership, during UAV operations near the edges of airports' premises. In addition, he pointed out that UAVs cannot identify windy or dusty areas, like manned aircrafts do, because UAVs lack such instruments. This issue was discussed by participants and the inputs will be evaluated in the applicable Work Packages.

Closing marks per panellist and workshop were given by Mr. Philippe Chrobocinski (Project Coordinator), who finally commented that we need to know the borders of airports and waterways because of private property issues, and Mr. Jannick Jestin (ENAC) added that Ownership mostly depends on Local Regulations. Additionally, there was a final discussion about GDPR, where Mr. Jannick Jestin (ENAC) proposed the deployment of algorithms to erase humans from pictures or video, like Google maps.

3 Participants

The main objective of the workshop was to initiate a conversation on relevant laws and regulations that might impose barriers or constrains to the operations, or even the development within the project. Thus, apart from the members of the 5D-AeroSafe consortium, the members of the advisory board were invited. Some indicative names are, Gonzalo Velasco, Business Plan and Innovation Director of FERROVIAL, Juan V. Balbastre Tejedor, participating in the EU-funded Bubbles project, and Robert Geister participating in the EU-funded INVIRCAT project. The complete and more detailed list of the project's advisory board can be found in the Annex 1 Section. All participants were eager to engage in the conversation and provided relevant and insightful information that enlightened the consortium and helped extract some useful outcomes.

4 Questions

To initiate the conversation between consortium partners and the advisory board, the organisers compiled a number of questions to be discussed upon, and hopefully answered, until the end of the workshop. These questions were also included in the agenda and some presentations. The main topics of the questions were the current issues, legislative, regulatory, or technical, concerning UAV operations and the coverage and efficacy of current legislation. Moreover, other questions targeted the assessment of the presented use cases within the project, as well as the possible collaborative endeavours towards the standardisation of UAV operations and making them a de-facto solution for ATC procedures. The questions are listed below in detail.

- What problems currently exist in Drones Operations?
- Which Use case is more crucial?
- Is the current legislation enough?
- How we can work to standardise the UAS definition?
- How can we work together with ATC to coordinate drone flights together with their daily ops?
- Which use cases within the coordinated and integrated frameworks represent the better balance between business opportunities and challenges/risks?

All questions were addressed and discussed upon, after the end of each relevant presentation. Participants took part in discussions that brought to the surface really helpful insights and conclusions.

5 Workshop Outcomes

After the presentation of the project's scope and objectives, from the relevant partners to the advisory board, specific questions, as presented in Section 4, were posed to intrigue the participants into a conversation on the issues and barriers concerning UAV operations and the validity of the current project requirements and use cases. Through that discussion, several opinions were presented, and issues were raised. This resulted in the extraction of new requirements that were not conceived in the initial design phase. Requirements concerning regulations, weather conditions during operations, and ethical issues. The outcomes of this discussion will be a direct input for WP2.

6 Conclusion

This document presented a detailed report of 5D-AeroSafe 's first workshop. The workshop's aim was to initiate discussions, between the consortium and the newly compiled advisory board, on the regulatory framework concerning UAV operations, the envisioned concept of operations, and the use cases, wherein the project outcomes will be assessed. This allowed the discovery of potential barriers or issues and ignited the extraction of new requirements for the project.

These outcomes will act as a direct input for Work Package 2, wherein the initial requirements and use cases are being designed. Eventually, this task will also assist Work Package 6, wherein the system architecture will be designed. Overall, the workshop shed light to some interesting issues, concerning operations and regulations, as well as known issues, based on past experience. This eventually led to the creation of new requirements and turned the attention of the consortium to certain issues and specificities of regulations that might pose barriers to the development of the project.

7 Annex 1

7.1 Advisory Board

filiation	Name	Role	Funding body	Email address
University of Valencia	Juan V. Balbastre Tejedor	Full professor at Universidad Politécnica de Valencia	BUBBLES - Separation Management Service, collision risk estimation, collision risk mitigation	jbalbast@itaca.upv.es
Labitynth	Rubén García García (CTO)	CTO	LABYRINTH - Temporary, centralised control of drones as a means of active deconfliction Expace On Board Systems, S.L.	rgarcia@expace.net labyrinth@inncome.es lfuente@expace.net
DLR	Robert Geister	Researcher - Nanodegree Program, Flying Car and Autonomous Fligh Engineer	INVIRCAT - RPAS in the TMA	robert.geister@dlr.de
E-GEOS SPA	Cristina Terpessi	Responsabile Servizi GIS - Program Office SIN Sistema Informatica Nazionale per l'Agricoltura presso e-Geos	ICARUS - Common Altitude Reference in VLL	cristina.terpessi@e-geos.it
NAPMA/PL MOD	Tomasz Kotas	RPAS insertion to ATM expert	ERA – Enhanced RPAS Automation (initiator)	tomaszkotas@o2.pl
FERROVIAL	Gonzalo Velasco	Business Plan and Innovation Director	End-User representative in the Consortium	gonzalo.velasco@ferrovial.com

7.2 Worksop Agenda

1ST 5D-AeroSafe Workshop on drone-based services and solutions for increasing the safety and security of airports and waterway

09:00 – 09:30 **Welcome from the ADS**

"Short presentation of 5D-AeroSafe Five services of Drones for increased airports and waterways safety and security."

Speaker: Mr. Philippe Chrobocinski AIRBUS

Chair/Moderator: Dr. Evangelos Markakis, Hellenic Mediterranean University, Greece

09:30 – 11:00 **Session One:**

"Analysis of U-SPACE Guidelines and discussion on the findings"

Chair/Moderator: Mrs Effie Makri, FINT, Greece

Panellists	20 Minutes	• Mr. Carlos del Río, Ferrovial, Spain Keynote talk on "Airport Environment Consideration and Recommendations of Operations"
	20 Minutes	• Mr. Yannick Jestin, Enac, France Keynote talk on " Current Regulatory Framework and future needs".
	20 Minutes	• Mr. George Nikolouzos, Water Airports, Greece Keynote talk on " 5D-AeroSafe Foreseen Use Cases".
30 Minutes	**Panel Discussion** With the speakers and the moderators trying to address the following Key **questions: What problems currently exist in Drones Operations? Which Use case is more crucial? Is the current legislations enough?**	

11:30 – 13:00

Closing Mark per panelist and Workshop Summary from Mr. Philippe Chrobocinski AIRBUS

7.3 Presentations

7.3.1 The project

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5D-AeroSafe Facts & Figures

5D-AeroSafe - „5 services of Drones for increased airports and waterways safety and security"

MG-2-8-2019 - Innovative applications of drones for ensuring safety in transport

Grant Agreement number: 861635

Total Funding: € 3 799 911,25

EC Requested Funding: € 3 497 475

Timeframe: 01.06.2020 - 31.05.32023

Consortium: 10 partners from 6 MS (3 RTO, 1 UNI, 3 SMEs and 3 END-USERS)

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5D-AeroSafe Consortium

- Airbus Defence and Space (Coordinator)
- Future Intelligence Ltd.
- Ecole Nationale de l'Aviation Civile
- Air Force Institute of Technology
- Vicomtech
- Hellenic Mediterranean University
- Ferrovial Corporacion SA
- Greek Water Airports
- AirMap Deutschland GmbH
- Eurocontrol

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Project motivation

The problem:
Airspace congestion and flight delays

- Disturb airline and airport operations.
- Considerable inconvenience to passengers.
- Pose significant safety concerns.
- Cause financial losses to airlines, airports and aviation authorities.

The demand:

- Maintaining safety and security of the involved stakeholders as a first priority.
- More efficient airtransport services and available resources.

The solution:

- Provide services for the safety and security of air traffic and airport management.

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Project scope

The main scope of 5D-AeroSafe is to develop a
solution for the safe and efficient integration of UAS in airport and waterway daily operations,
that will:

- **Conduct Flight Inspections**, i.e. inspections and calibrations on CNS (Communication, Navigation and Surveillance) systems and landing visual aids,
- **Safeguard airport restricted areas**,
- **Inspect runways and taxiways** (and water runways) to detect Foreign Object debris or any other threat to aircraft movement on the ground (and water surface).

This concept will allow the smooth operation and integration of UAS in Aerodrome ATM (Air Traffic Management) systems via the co-operation with UTM (Unmanned Aircraft System Traffic Management) Systems, enhancing mutual situation awareness.

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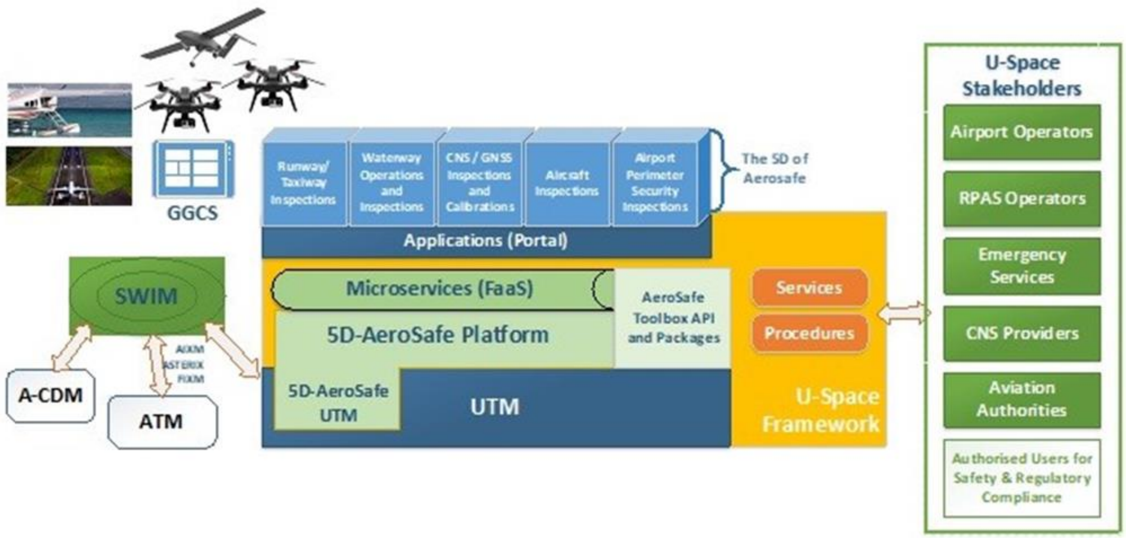
Main concept of 5D-AeroSafe



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Project challenges

5D-AeroSafe will study and implement UAS-based solutions to enhance the airport operations in the domain of:

- Sensors calibration: the project will develop a sensor that will be embedded on a UAV (to replace the calibration with piloted aircraft - more expensive due to aircraft and pilots)
- Platform safety: the UAVs equipped with cameras will inspect the runways and taxiways (resp. waterways) to detect anomalies (FODs or defects) that could raise problems to the aircraft movements (to replace inspections by teams in car, longer and more expensive)
- Platform security: similarly, the system will search for abnormal behaviors of persons or vehicles in the perimeter of the airport and in the vicinity

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Ultimate result

Platform built as part of the established UTM

Conforming to the applicable regulations, and the services and procedures described in the U-Space framework as well requirements of the involved shareholders, 5D-AeroSafe, based on the development of appropriate functions, will provide **an application portal as well as a toolbox with APIs and packages ready to supply the "5-Dimensions" of 5D-AeroSafe**.

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Project results

The UAVs will operate in an area where potential conflicts are numerous, so the 5D-AeroSafe system needs to take care about the safe integration with ATM and ground movements:

- A Generic Ground Control Station (GGCS) manages all the UAV missions through an integration of the respective specific Ground Control Stations. The missions received from the tower are allocated to the UAVs with a preliminary mission preparation that will be completed at GCS level. In the other way round, the data received from the UAVs are exploited at GCS and GGCS level to send the mission report to the tower.
- The 5D-AeroSafe platform will manage the UAV missions (UTM).
- Seamless UTM/ATM coordination for non-segregated airspace.

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Technical challenges

- Development of a calibration sensor that can be integrated in the project UAVs.
- Adaptation of UAVs to fulfill the project missions.
- Development of a GGCS able to manage the project missions.
- Development of a UTM platform for airport operations.
- Integration of UTM and ATM through the connection with the airport legacy systems.

CONOPS

To provide the uses cases and scenario definitions for the pilots, forming the concept of operations of the system (CONOPS)

- To determine the list of requirements and associated KPIs for the 5DAeroSafe solution from the users' perspective.
- To investigate adherence to the relevant regulatory frameworks (ICAO Annex 10, ICAO Doc 8071, NPA 2017- 05) and its application to the resulting system and to examine potential ethical/legal aspects for implementing the UTMS at airports.

Project schedule

Phase	WP	Est. Due Date
Phase 0 -Planning, Management	WP1- Project Management and IPR Management	31 May 2023
Phase 1- Requirements, Regulations, Concept of Operations:	WP2- Concept of Operations and Regulatory Framework	28 Feb 2021
Phase 2- Development and Testing	WP3 -UAV and Payload Hardware Adaptation and Implementation	30 Nov 2022
	WP4- Video Analytics and CNS inspection Analysis	28 Feb 2022
	WP5- Core 5D-AeroSafe Platform Development	28 Feb 2023
Phase 3- Demonstration and Validation	WP6- 5D-AeroSafe Architecture Definition, Integration and Pilots	31 May 2023
Phase 4- Dissemination and Communication Activities, Innovation Management and Exploitation Activities	WP7- Innovation Management and Exploitation Activities	31 May 2023
	WP8- Dissemination and Communication Activities, and User Advisory Board Management	30 Apr 2023

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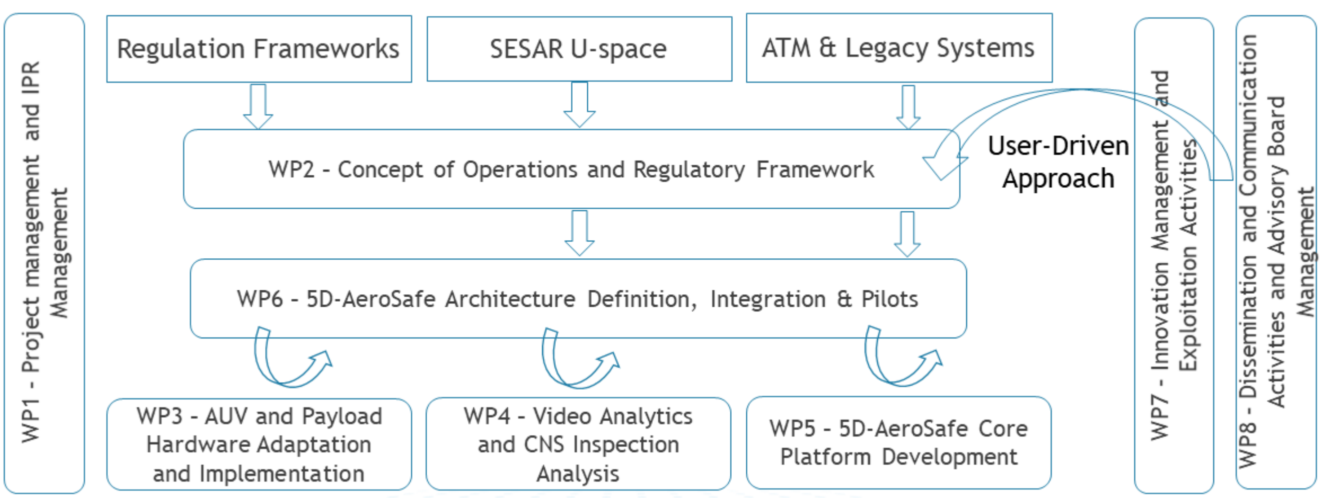
5D-AeroSafe Work Plan Structure



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7.3.2 Operations

Intro

Unmanned Aircraft Systems (UAS), Remotely Piloted Aircraft Systems (RPAS) or 'drones' have seen a rapid technological development in recent years and will continue to do so in the coming future.

The number of applications seems endless but some realism has to be applied too, in order to manage expectations.

The main challenge for airports is to find the right balance between business opportunities (advantages) and challenges/risks (disadvantages)

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Airport environment - Responsibility

The airport operator can only be held responsible for activities inside the airport boundaries.

For drone activities outside the perimeter, the responsible entity for that area needs to ensure that appropriate arrangements have been made since the drone activities may fall outside the airport jurisdiction. This is key for perimeter and approach systems inspections.

The airport operator has to ensure the collection of all necessary drone operations approvals:

- Operational need/business case
- Type of drone operation
- Safety aspects
- Security aspects
- Capacity impact

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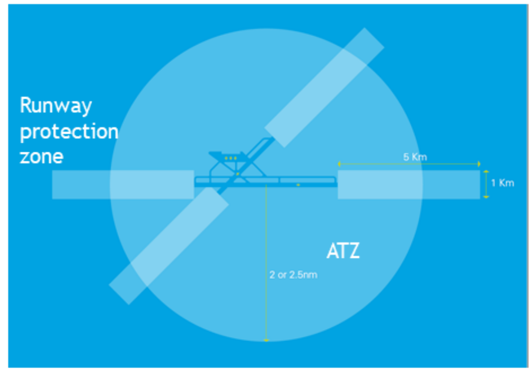
Airport environment - ATZ

Aerodrome Traffic Zone - ATC - is defined as an airspace of defined dimensions established around and aerodrome for the protection of aerodrome traffic.

The ATZ is intended to protect the aerodrome traffic including the aircraft in the aerodrome traffic circuit. Generally, the ATZ is considered to be a "small-volume" airspace, usually a cylinder extended in from the surface up to a few thousand feet with a radios of a few nautical miles.



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Airport environment - ATZ

No Fly Zone	Apply to Fly Zone	Advise and Fly Zone
Red Zone	Amber Zone	Green Zone

No Fly Zone – Red Zone

Drone operations are not compatible with other airspace users.

ATC must perform an assessment to determine if the operation can be performed.

Not likely approval. Will carry significant conditions if so

Apply to Fly Zone – Amber Zone

Drone operations may be compatible with other airspace users.

ATC must perform an assessment to determine if the operation can be performed.

Likely approval, may carry some conditions.

Advise and Fly Zone – Green Zone

Drone operations are compatible with other airspace users.

ATC is advised prior to and following an operation.

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Airport environment - NOTAM

Apart from ATZs, there is a NOTAM system for notifying blocks of airspace where particular limitations are placed on the flight of all aircraft (manned and unmanned).

At airport level, airspace may have temporary restrictions imposed at specific times, either as a result of a longer term pre-planned event, or in reaction to a short notice occurrence, such as an emergency incident.

It is important to note that these restricted areas apply to all aircraft including drones, regardless of weight or height of operation.

Q) EGTT/QOBCE/IV/M /AE /000/004/5129N00014W
A) EGLL
B) 20/09/08 01:00 C) 20/12/07 23:59
E) CRANES. CONSTRUCTION SITE CRANES OPERATING AT PSN 512915N 0001330W (HAMMERSMITH AND FULHAM, LONDON). UP TO 311FT AGL/315FT AMSL. FOR INFO CONTACT 07940 055212. ON EXPIRY OF THIS NOTAM DETAILS WILL BE INCLUDED IN THE UK AIP ENR 5.4. 2020-09-0050/AS4

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Airport environment - UAS and height limit

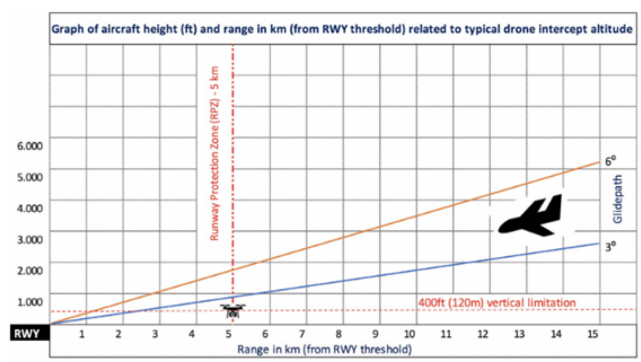
The UAS Geographical Zone consists of two separate zones:

- The ATZ of the aerodrome
- The runway protection zone

Height limitation is intended to contribute to the safety of manned aircraft from the risk of collision with a small unmanned aircraft. With the obvious exception of take-off and landing, the majority* of manned aircraft fly at heights greater than 500ft from the surface.

Flying a small unmanned aircraft below 120m (400ft) scientifically reduces the likelihood of an encounter with a manned aircraft

Exceptions: Police, Air Ambulance and Search and Rescue helicopters, as well as military aircraft .



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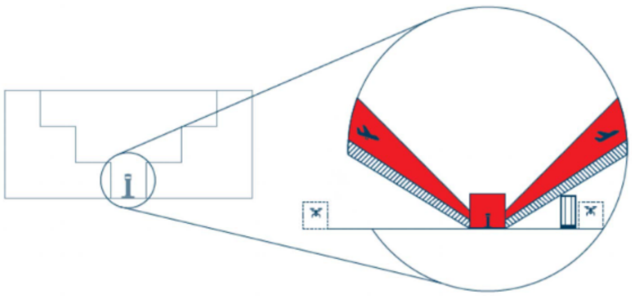
Drone Operations

Segregated operations

Operations that would normally impact on ATC, but the characteristics of the requested location mean that direct interaction with ATC is not required and ATC can work independently around the drone(s) operation.



Not interesting for AeroSafe purposes

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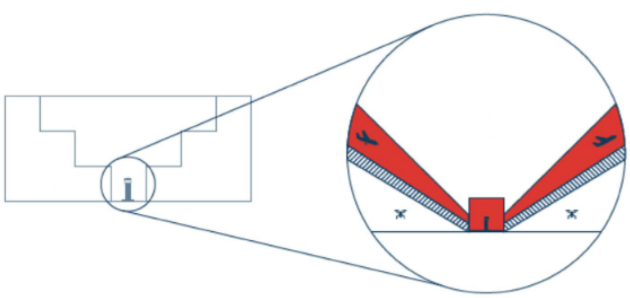
Drone Operations

Coordinated operations

Operations where interaction with ATC is required, as determined through assessment of the characteristics of the location and equipment levels and capability of the drone. These operations will need an appropriate risk assessment and may need to have a standard "Drone Buffer" applied in order to provide a proper separation between the drone operations and manned aircraft (in the air and on the ground) to mitigate the risks as much as possible



Potentially interesting for AeroSafe purposes: perimeter inspections, VOR calibration, etc.

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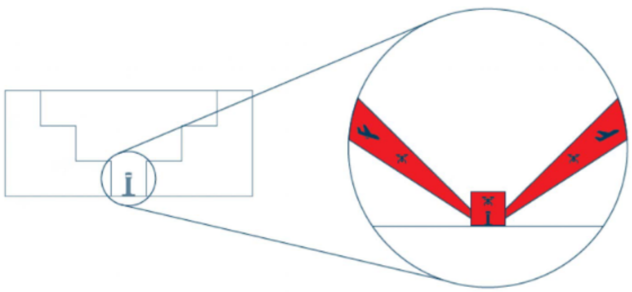
Drone Operations

Integrated operations

Operations where the equipment levels and capability of the drones are highly reflective of conventionally piloted aircraft, and they can be largely managed through systems and processes. Integrated Operations are typically capable of presenting real-time navigational information using (conventional) navigation systems and maintain continuous two way communications with ATC.



Highly interesting for AeroSafe purposes: surface inspections, FOD, PAPI calibration, etc.

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Drone Operations

Integrated operations

Due to the existing technological gap, along with results found in air trac simulations highlighting the need for extended downwind travel and wake turbulence avoidance, ATC and/or the CAA are likely to keep drones segregated from manned aircraft in the name of flight safety, and a desire not to disrupt normal airport operational capacities.

AeroSafe research, development and trials shall provide information that may aid the development of airport operational standards in the future.

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Prerequisites

Before any drone operations can be authorised within a UAS Geographical Zone, arrangements need to be made considering the following aspects:

- Operator/drone pilot known and registered
- Operator/drone pilot licenced and trained
- Acceptable equipment
- Confirmation of adherence to all applicable EASA and national/local regulatory requirements
- Equipment meeting conspicuity requirements (E.g. by mode-S transponder (used by manned aircraft), or different methods to broadcast the drone's position at close range by Bluetooth or Wi-Fi transmitters, or via a cellular communications network. The options may change as technology evolves. Alternative arrangements are possible, to the satisfaction of airport operator/ANSP)
- Appropriate third-party liability insurance arranged for commercial operators
- Operational Manual available and maintained

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5DAEROSAFE

Prerequisites

Before any drone operations can be authorised within a UAS Geographical Zone, arrangements need to be made considering the following aspects:

- Drone Pilots must give priority to all manned aircraft and stay well clear of the flight path.
- Drones must be flown at a safe distance from people and buildings
- Detailed scenario/flight plan
- VLOS, daylight only (Daylight restriction could be lifted if risks associated with night operations can be mitigated properly and risk assessment guarantees safe and secure operations.)
- Safety assessment for the specified operation (SORA completed by aerodrome operator and ANSP analysis)
- Airport manager (written permission)
- Civil Aviation Authority permission
- Coordination and communication protocol with ATC (approach, TWR) and airport operator (single point of contact if possible)
- Go/No-Go decision protocol arranged.

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Previous experiences

SOU Robird® trial - scope

Trial of an Unmanned Ornithopter, drone, for Bird Management during two months (September to November 2017) at Southampton Airport (SOU).

Analyse drone's integration as a complementary measure to current Wildlife Management Measures.

Demonstrate and inform a decision regarding safe use of Unmanned Aerial System within a Controlled Traffic Region (CTR).

Collect data to inform a wider decision on the potential adoption of an Unmanned Technology.

Reduce risk to operators and customers of the airport.

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Previous experiences

SOU Robird® trial - trial

Phase 0: Pre-project documentations preparation obtaining the required permissions and authorizations on behalf of Civil Aviation Authority (CAA).

Phase 1: Demonstration of Robird's safety systems

- Flights outside the Airport boundary.
- Tests of geofencing, low battery, pilot incapacity, GPS connection lost tests.

Robird Flight Area after Phase 3

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Previous experiences

SOU Robird® trial - operations

Phase 2: Eastern side Operation

- Flights inside the airport fence and under the control of ATC (call sign ROBIRD-1).
- Full bird control in action without entering in the manoeuvring area.
- Didn't cover the runway.

Phase 3: Runway Operation

- Flights inside the airport fence from the western edge till the eastern perimeter of runway and under the control of ATC (call sign ROBIRD-1).
- Full bird control in action entering the manoeuvring area.

Robird Flight Area after Phase 3

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Previous experiences

SOU Robird® trial - conclusions

A proof of a secure mean to be operated within any Airport Operational Area. Trial supposed no safety incidents for SOU Airport Operations.

Operations were coordinated with ATC using call sign ROBIRD-1 (no UTM system).

Definition of normal operation was important but safety procedures (fail safe) for situations as GPS loss, catastrophic failure, communications loss etc, was key to get clearance for the operation.

The number of bird strikes decreased substantially during the months in which Robird was being tested at the airport.

Effective in herding airborne birds. It has been proved that birds of prey can be redirected by fighting using Robird.

A responsible approach to drone exploitation has been verified. It has been demonstrated that Robird could be implemented as a complementary means/methods for bird control.

Opportunity to reduce the potential liability to aircraft operator claims.

Improvement in aircraft operational reliability: less operational disruption and more reliable scheduled operations.

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Previous experiences

SOU pavement condition inspection - scope

The objective of the trial was to demonstrate the capability of using current within visual line of sight (VLOS) drones to replace Southampton Airport manual inspection activities.

A series of drone inspections defined by Amey-VTOL, Ferrovial Airports, Ferrovial and Southampton Airport were undertaken, covering pavement condition inspections (Stands, taxiways and runway): level L1 (15 min/day), L2 (180 min/month) and L3 (180 min/year)

During five hours of operation, the drone was able of shooting both high definition video and more than 900 high definition still images being carried out at 5m, 10m and 20m height.

Both formats produced images in which defects such as small cracks could be detected to a level of accuracy similar to the naked eye. The degree of this accuracy clearly improved the lower the drone was flown.

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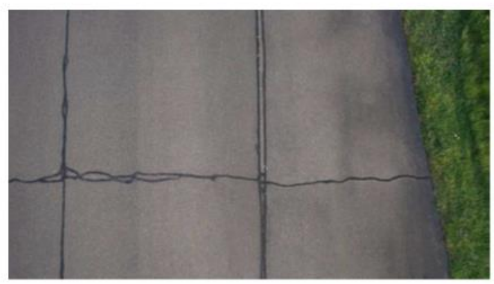
Previous experiences

SOU pavement condition inspection - conclusions

It was concluded the technical feasibility of using drones for the activities mentioned. Therefore, the use of drones could lead some qualitative advantages:

- More consistent data in imagery
- More repeatable, accurate data
- A higher resolution of data coverage
- A reduced risk to the workforce by not having to work in an operational airport environment
- Time savings

Positive business case for deploying drones for building inspections and L3 pavement inspections were demonstrated with this PoC (Proof of Concept).



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Recommendations

- Drone Fly Zones. The key enabler. Suite of three dimensional maps that specify the location of the zones for each protected aerodrome. Competent Authorities/ANSPs are recommended to develop standardised specifications to identify the requirements for the three different Drone Fly Zones.
- Airports/ANSPs need to check if any of their IFP (instrument flight procedures) have protected zones that could interfere with the 120m (400ft) vertical limitation and take appropriate action where needed. Deviations from above recommendation could be possible on a case-by-case basis, only after conducting a safety assessment ensuring the additional risks can be mitigated (e.g. crossing traffic at low altitude.
- It is recommended that ANSPs develop standard buffers in order to separate drone operations from manned aircraft movements (in the air and on the ground). These buffers could be incorporated in the Standardised Use Cases, facilitating a standard approach to risk mitigation measures at least until effective technologies and protocols are widely available and deployed.
- The safety/security risk assessment should include identifying sensitive infrastructures and/or areas and consider developing specific procedures for these 'hot spots'.

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Inputs

- How we can work to standardise the UAS definition?
- How can we work together with ATC to coordinate drone flights together with their daily ops?
- Which use cases within the coordinated and integrated frameworks represent the better balance between business opportunities and challenges/risks?

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ENAC
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AIRBUS DEFENCE & SPACE
EUROCONTROL
vicomtech
Technological Educational Institute Of Crete
AIRMAP
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7.3.3 Regulatory Framework

initiatives

1 - ACI intl
ICAO guidance material
Mention a few H2020 project names. (CORUS CLASS Riga)
New projects ER4: Bubbles, etc.
PJ34 IR: u-space services ?

Regulatory Framework - Different relevant frameworks

1 - Manned aviation regulations
2 - UAS regulations according to the context of our operations
3 - UTM ATM integration regulations
4 - 5D and UTM regulations

1 - Manned Aviation

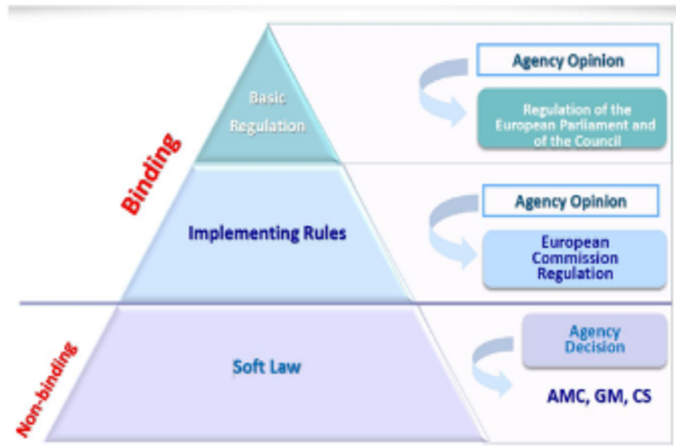
- General regulation:
  - Standards And Recommended Practices (SARPs) from ICAO
  - ICAO annexes
- In Europe:
  - Standardized European Rules of the Air (SERA) produced by EASA
  - Commission Implementing Regulation No 923/2012 from the European Union
- National scale:
  - Responsible for their airspace organization
  - Specific authorizations (NOTAMs)
- Local exemptions, ex: Annex II and 500ft

1 - Manned Aviation

- Application example:
  - According to SERA, VFR flights have a 150m/500 ft (300m/1000ft above cities) minimum height
  - This could create a “natural” boundary between small UAS and manned aircrafts
- Objectives:
  - Understand the current state of the airspace (e.g. Riga Airspace Assessment)
  - Towards an automatization of the UAS procedures (UTM/U-space services)

2 - UAS Regulations

- Hard/Binding laws
  - Delegated Regulations (e.g. (EU) **2019/945**)
  - Implementing Regulations (e.g. (EU) **2019/9**
- Soft/Non-binding laws
  - Acceptable Means of Compliance (AMC)
  - Alternative Means of Compliance (AltMoC)
- Conception rules **<= out of scope**
  - Certification Specifications(CS)
  - EU 2018/1139
- Local exemptions … too: security, etc.

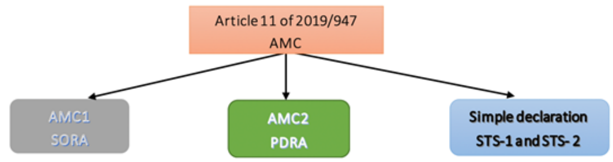


2 - UAS Regulations

- Commission Delegated Regulation (EU) **2019/945** of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems
- Commission Implementing Regulation (EU) **2019/947** of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft
  - Different (sub) categories of UAS operations (see next slide)
- Other actors
  - EUROCAE
  - Joint Authorities for Rulemaking on Unmanned Systems (JARUS)

2 - UAS Regulations

- Article 11 of **2019/947**: 3 AMCs
  - AMC1: Specific Operation Risk Assessment (SORA)
  - AMC2: Predefined Risk Assessment (PDRA)
  - Standard Scenarios (STS-1 and -2)



- What about 5D operations?
  - Open category
  - Specific category
    - STS-1 for VLOS (max height 120m)
    - STS-2 for BVLOS (2km max, 120m max)
    - SORA
    - PDRA
    - LUC etc.

3 - UTM ATM integration issues

- UTM Guidance from ICAO

- Different fields of study still evolving
  - SESAR projects (e.g. Concept Of Operations For European UTM Systems - CORUS)
  - Different airspace structure (e.g. LFR-HFR cf. figure)
  - Geo-awareness
  - UTM areas (non segregated airspace)

- Benefits from UTM for the ATM to go beyond NOTAMs etc.
  - 5D: help streamline the process

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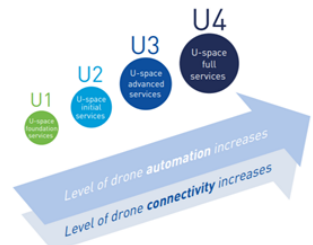
4 - UTM Regulations

- Still in progress:
  - Opinion EASA 2020-01: High-level regulatory framework for the U-space, discussions at EU level, next step early 2021
  - Evolution of U-space services (ATM Masterplan ?)
  - Normalization process: ISO, ANSI, ASTM, EUROCAE (e.g. EUROCAE WG105)
  - Many other ongoing projects
    - ISO TR 23629 - UAS Traffic Management (UTM)
    - prEN4709-3 Aerospace series - Unmanned Aircraft Systems (UAS) - Security Requirements
    - …



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Conclusion & Discussion

- TODO:
  - List all that has been said above in the D2.1
  - Follow any evolution (e.g. AW-Drones project)
- About 5D:
  - Hypothesis on the operation category
  - Show that 5D technologies are a gain for the safety of both unmanned and manned flights
    - E.g. It could be shown that 5D techs can lower the ARC & GRC of a SORA
  - Show that 5D technologies allow airport/waterport operations with an acceptable safety level
  - Show that these operations are business compatible
- We make the hypothesis above and we try to adapt to a moving target (3 trials & 2 ConOps versions)

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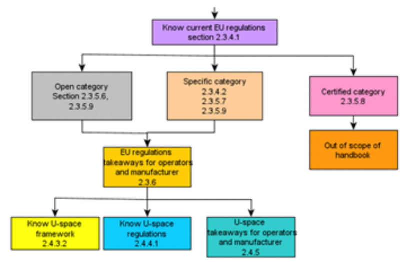
Quelles reglementation sont pertinentes ?



2 - **UAS:** on veut faire voler des drones en aéroport et hydroport (en CTR, classe A ou D)

VLOS BVLOS

1 - **ATM:** on veut améliorer la safety du trafic aérien (maritime)

4 - grâce à des technos U-space **UTM** et de nouvelles technologies "5D"

quels sont les cadres règlementaires: UAS, ATM, UTM

3 - UAS/ATM integration: ICAO requirements [22]

rôle de l'EASA: maintain current level of safety for manned aviation

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1 - Manned Aviation

Traduction des SARPS et annexes ICAO en doit européen: EUROCONTROL has been mandated to produce Standardized European Rules of the Air (SERA). SERA (Standardized European Rules of the Air (Commission Implementing Regulation (EU) No 923/2012)). C'est la loi pour l'aviation habitée.

Ouverture: According to the Standardized European Rules of the Air (SERA), 150m/500ft is the lowest available VFR altitude (300m/1,000ft above towns), and thus creates a possible boundary between small UAS and manned aircraft. [22]

Compétence de l'état pour l'organisation de l'espace: -> autorisation spécifiques.
aujourd'hui: NOTAM et plein de choses
demain ?

comprendre l'état des lieux de l'airspace (cf: RIGA), le + automatisé possible (services U-space ?)

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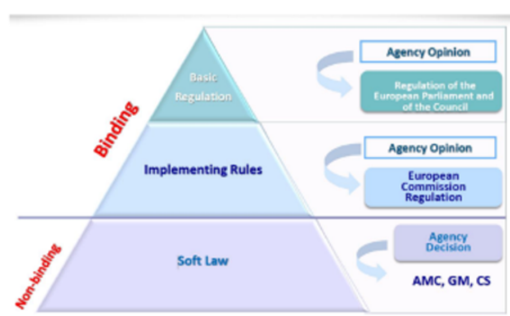
2 - UAS Regulations

SN	Name of documents	Type of documents
1	Commission Regulation (EU) No 748/2012 Initial Airworthiness [12]	Applicable manned aircrafts regulations
2	Commission Regulation (EU) No 2015/640 Additional airworthiness specification. [13]	
3	Commission Regulation (EU) No 1321/2014 Continuing Airworthiness. [14]	
4	EASA E.Y013-01 Policy statement airworthiness certification of UAS. [15]	Applicable UAS Regulations
5	Basic regulations EU 2018/1139 common rules in the field of civil aviation [16]	
6	Delegated regulation EU 2019/945 on unmanned aircraft systems and on third country operators of unmanned aircraft systems. [17]	
7	Implementing regulation EU 2019/947 Rules and procedure for the operation of Unmanned Aircraft. [18]	
8	Commission Implementing Regulation (EU) 2020/639 [19]	
9	Commission Implementing Regulation (EU) 2020/746 [20]	
10	European ATM master plan 2020 [21]	UAS baseline document
11	UAS-ATM integration operational concept published by EASA and Eurocontrol Version-1 [22]	
12	CORUS explanatory research [23]	
13	EUROCAE ED-79A/ SAE ARP 4754A Guideline for development of civil aircraft and systems [24]	Manned aircraft standards

pour 5D: hard = IR, DR, soft: AMC, AltMC

regles de conception: CS (ex (EU) 2018/1139 - : out of scope



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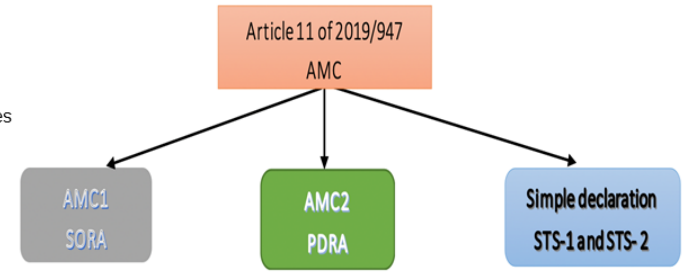
UAS reg suite:

Commission Delegated Regulation **(EU) 2019/945 of 12 March 2019** on unmanned aircraft systems and on third country operators of unmanned aircraft systems covers mostly:
- CE and operator markings on a UAS.
- Technical requirements per UAS category
- Obligations of manufacturers, importers and distributors of UAS
- Requirements on non-EU country operators
- Remote identification

Commission Implementing Regulation **(EU) 2019/947 of 24 May 2019** on the rules
- **Different (sub) categories of UAS operations**
- Rules, procedures, competency and minimum age for pilots
- Cross border operations
- Registration of UAS operators
- Tasks and designation of competent authorities



. **Specific operations risk assessment (SORA)** [28] **is AMC1 to Article 11 of the UAS Regulation.**

on aura soit SORA, (soit PDRA, +LUC) , soit STS

5D: STS-01 pour VLOS,
STS-02 pour BVLOS (2km max, 120m max, à voir)

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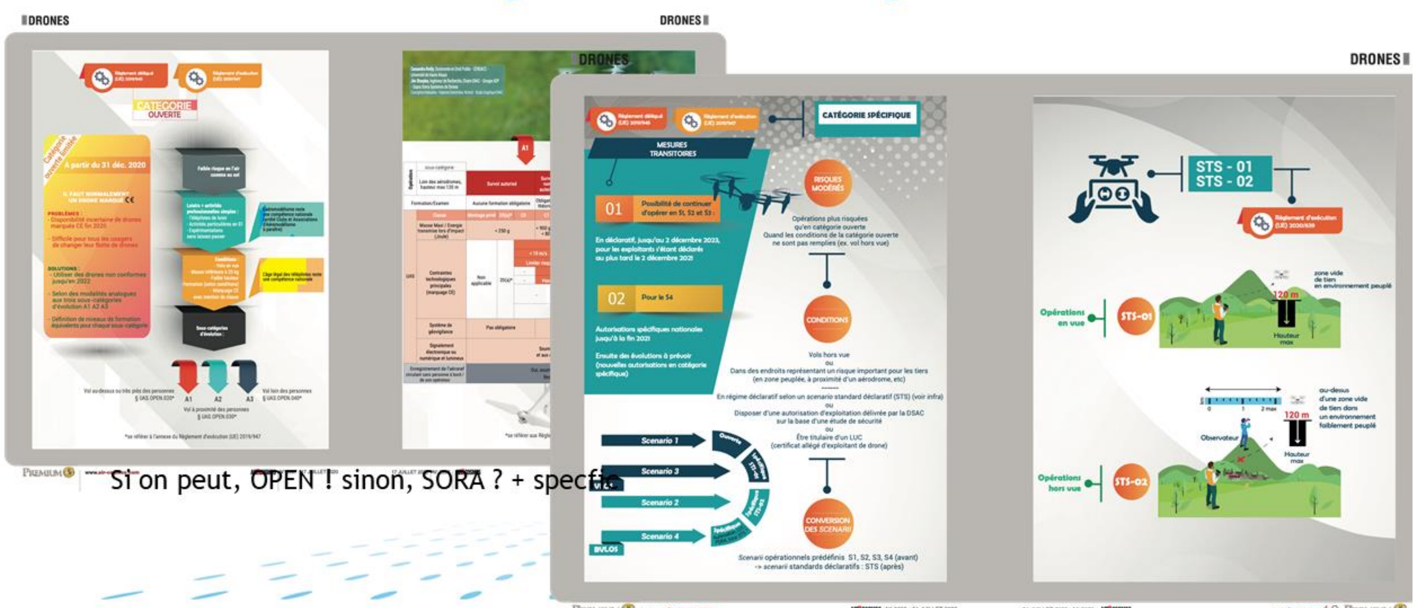
UAS reg suite: categories



Si on peut, OPEN ! sinon, SORA ? + specific

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Autres

EUROCAE

JARUS: operation centric SORA

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3 - UTM ATM integration

propositions ICAO

CONOPS: Operationnal Concept, CORUS
- structurer l'airspace ? ex: LFR HFR …
- geo awareness
- UTM areas - towards non segregated ?

Visual Flight Rules	Instrument Flight Rules	Low-level Flight Rules	High-level Flight Rules
VFR	IFR	LFR	HFR
ICAO Annex 2 Chapter 4 SERA 5001-5010	ICAO Annex 2 Chapter 5 SERA 5015-5025	To be developed	To be developed
General Flight Rules ICAO Annex 2 Chapter 3 SERA Section 3			

Quels bénéfices de l'UTM pour aller au delà des notam, etc.

5D - streamliner le process, niveau de confiance.

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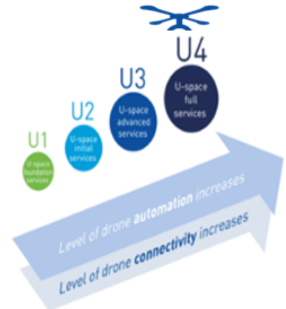
4 - réglementation UTM



U-space 2016, projets SESAR (dont CORUS) ER2 IR ER4

en cours:

- Opinion EASA 2020-01, discussions en cours. Key principles
- U-space framework ? corus, etc. évolution des services
- SG31 EUROCAE WG105
- de façon générale, plein d'initiatives, cf EUSCG rdp (en lister quelques unes)

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Discussion

Travail en cours:
lister tout ça dans le D2.1
suivre les évolutions, e.g. projet AW-drones, initi ECTL

Faire des hypothèses:

- le choix des catégories d'opération
- avec 5D, on montre que les technos 5D améliorent la safety (pour SORA, ARC— GRC— des mitigations) des vols de au bénéfice de la safety des vols habités
- et permettent de faire des opérations airport/waterport avec un niveau de sécurité acceptable, de façon business compatible

proposition: on fait les hypothèses ci-dessus, on va s'adapter à une cible mouvante, car 3 familles de trials, 2 versions de conops

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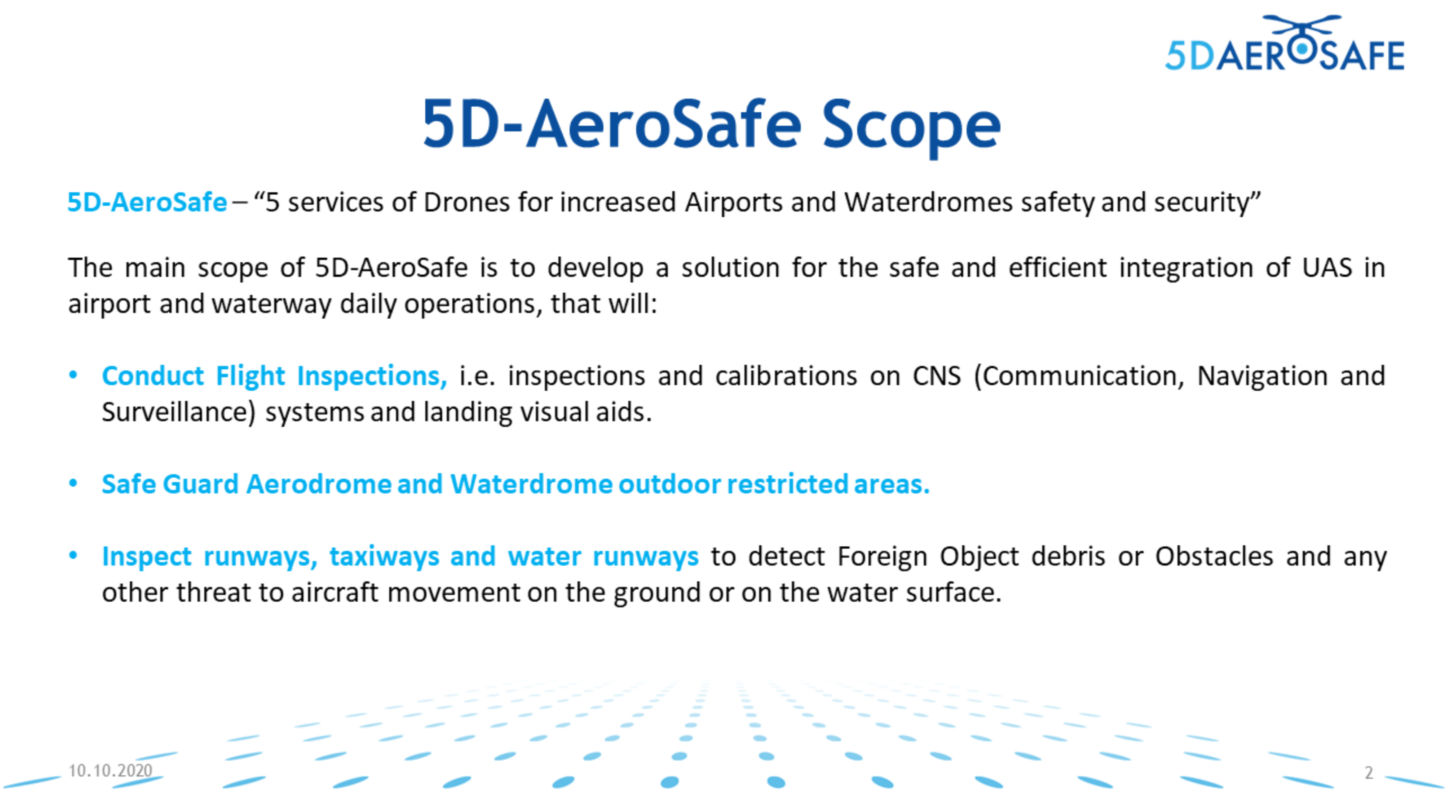
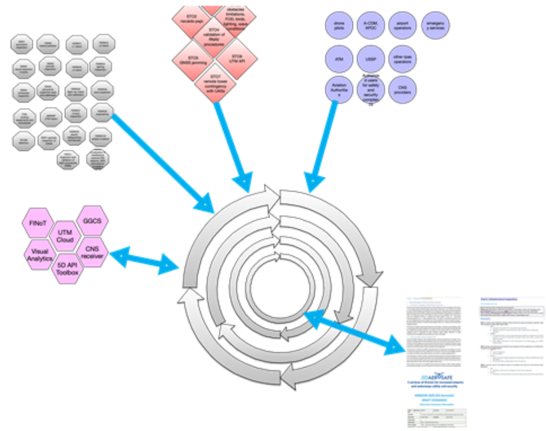
7.3.4 Use Cases



Use Case design process



Input: needs gathered by experts of airports and waterports, knowledge on drones, UTM, technology providers

Iterative design process based on

- scientific and technical objectives (STO): GNSS transceiver, navaids and PAPI, obstacles FOD, validation of RNAV procedures, GNSS jamming, UTM API, remote tower contingencies
- improvement of the TRL of 5D technologies put together (FINoT, UTM Cloud, GGCS, Visual Analytics, 5D API Toolbox, GNSS receiver)
- focus on end users and stakeholders: drone pilots, APOC, airport operators, emergency services, ATM, USSP, authorities, authorized users

Outputs:

- Trials A, C, D, each one with different scenarios and missions
- CONOPS, User requirements, detailed use case description

3

For each use case

- Describe **work scenarios**: end user needs, description of the environment, workflow, output of relevant missions.
- Turn those work scenarios in **design scenarios** with UAVs, assess the operations (VLOS, BVLOS, UAS technologies, such as D-GPS, C3link). Refine those scenarios in different **missions** if necessary.
- Consider **unexpected events**, caused by the environment or by the missions, and describe mitigation procedures.
- Describe the benefits of the **5D technologies**: UTM Cloud, FINoT, 5D API, identify the relevant U-space/UTM exchanges between **stakeholders** to foster the CONOPS design and the safety assessment.

Iterate ! A lot !

4

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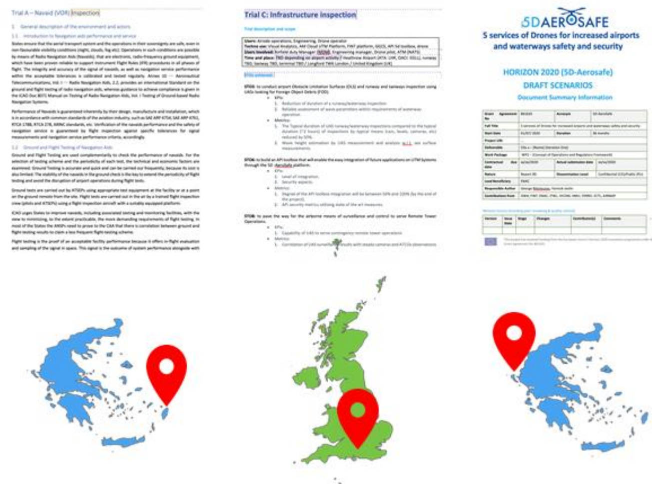
Use Case List

Trial A: Navaids inspection

Trial C: Heathrow Airport operations

Trial D: Increased airport and waterway safety and security



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Trial A: Drones in Navaids Inspection

Navigation Aids (navaids):

a. Need to be ground and flight calibrated and tested periodically, to verify that the radiated signals are within acceptable tolerances

b. The flight inspection nominal periodicity can be extended by demonstrating correlation between flight inspection measurements and measurements taken from CNS transceivers (specialized for navaids) carried by drones in medium range (further than ground testing and closer than flight testing distances) operations

c. A set of periodic drone-based inspections on navaids may verify the correlation

Scientific & Technical Objectives (STO):

- STO1: To conduct flight inspection of conventional navaids using suitable CNS transceivers carried by UAVs
- STO2: To achieve calibration for non-precision approach navaids, using UAV
- STO6: To build CNS inspection applications in UTM that will be integrated in the API toolbox

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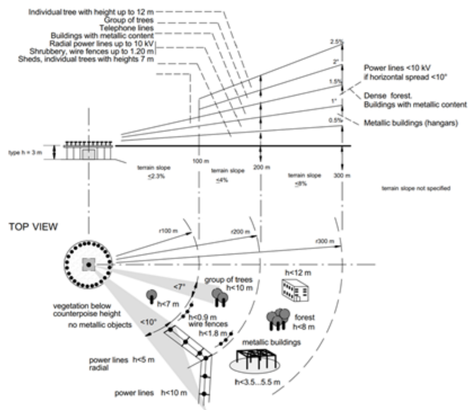
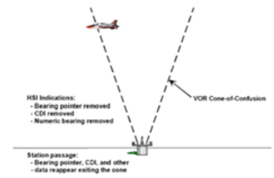
Operational Need

5D-AeroSafe targets the inspection of VOR ground navaid, in different ways adapted to each user needs:

- VOR long-range ground testing for ATSEPs
- VOR short-range flight testing for flight inspectors (ATSEPs and pilots)
- DME/DME RNAV performance testing for flight procedure designers



VOR safeguarding and obstacles around installation (ref. Thales)



VOR Cone-Of-Confusion

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Scenarios Description

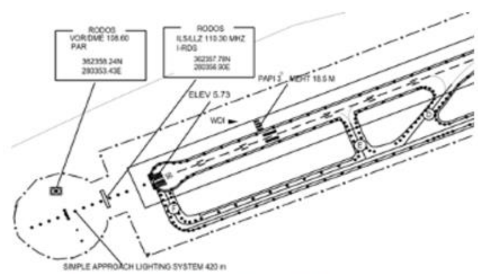
Users: ATSEP ground operators doing monthly checks as part of the ANSP in airport

Technologies: CNS Tranceiver, AM Cloud UTM Platform, FINoT platform, GGCS, API 5d toolbox, drone, DGPS

Location: Rhodes airport , VOR is at the end of the runway, daytime

Scenario 1: three VOR inspection mission: extended ground check, long-range ground test, short range flight test. One or multiple multicopters, VLOS and BVLOS.

Scenario 2: one DME/DME evaluation mission, to help validation of RNAV procedures. Fixed wing drone, BVLOS.



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VOR Inspection Missions

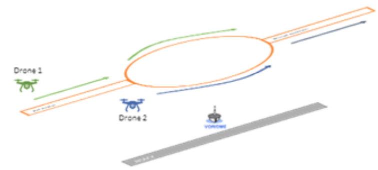
The missions will showcase the capability of 5D-AeroSafe to provide a safety view on the drone missions in a busy safety critical CTR area. Once drone inspections show significant correlation with platform's mission, they will become a routine.

Extended Ground Test

The benefit of the mission is that ATSEP can create a quite automated procedure of measurements and a routine check that can be used in cases that the space around a VOR has changed significantly and it needs to be evaluated.

Short Range Flight Test

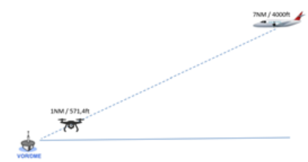
The benefit of the mission is to demonstrate the capability of the 5D-AeroSafe platform to initiate a request for an ad-hoc specific operation from the Tower in a non-predefined space and time



Typical inspection paths with two drones

Procedure

- ATSEPs deploy 2 drones from suitable positions close to the VOR
- Both are multicopters with VTOL capabilities (i.e AtraxM)
- During a joint 30 minutes flight the drones cover 10NM of distance at nominal speeds (5.6m/s equivalent to 10.8 kts ground speed)
- Each drone may check half orbit of a 1000m radius & 1000m axial performance in 3 critical for the operations radials
- The use of 2 drones is to minimize the duration of the inspection and to check both VOR transmitters (main – standby) in a dual station setup



Drone will capture the same LoS signal as a flight inspection aircraft at a typical orbit

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DME/DME Evaluation Mission

The mission will demonstrate the possibilities to support with drones measurement campaigns that verify the adequacy of DME/DME combined signal. In this mission the combination of RDS and PAR DMEs will be evaluated in various heights

- A minimum sector altitude (msa) of 2000ft and 3000ft is assumed
- The ceiling of the drone is not that high, yet measurements can be taken at lower altitudes that are reachable with the drone and are also safe
- Once results for DME/DME coverage are adequate to support operations in areas with challenging terrain in a TMA and at heights that are below the msa, there will be enough evidence that signal is also acceptable at higher altitudes

The envelopes where DME/DME signal is available and useful

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Trial C: Airport Operations

Safety of airport operations:

a. Many safety inspection are performed on a airport platform: terminals, runways, taxiways, stands, lighting, fence security, etc.

b. Drone operations could bring many benefits to the Airside Safety Department, provided the safety of everything and everyone can be achieved by the 5D technology, linked to APOC, ATC, etc.

Scientific & Technical Objectives:

- STO3: to conduct airport Obstacle Limitation Surfaces (OLS) and runway and taxiways inspection using UASs looking for Foreign Object Debris (FOD).
- STO6: to build an API toolbox that will enable the easy integration of future applications on UTM Systems through the 5D -AeroSafe platform.
- STO8: to pave the way for the airborne means of surveillance and control to serve Remote Tower Operations.

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Heathrow runways 09R 27R

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Heathrow T2+2B T3 T4 (T5+5B+5C)

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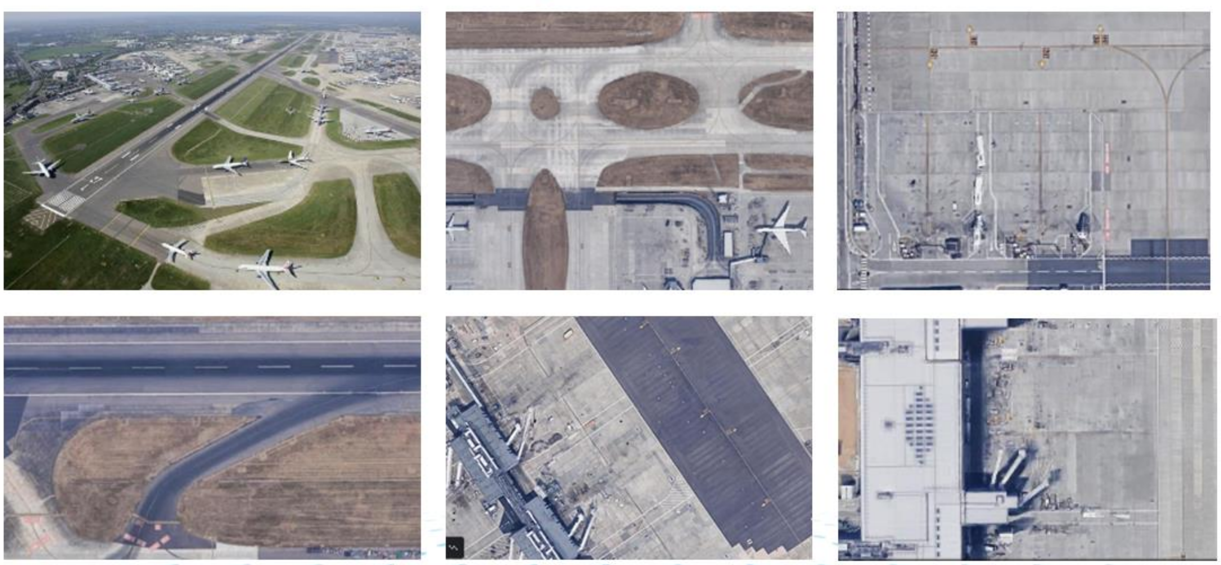
Taxiways and Stands



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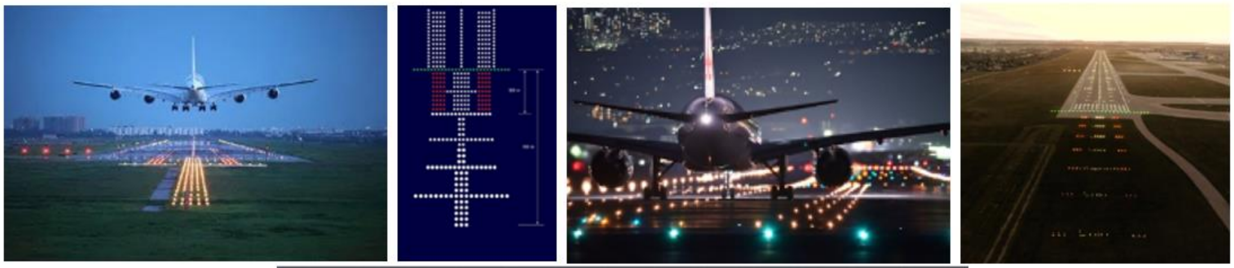
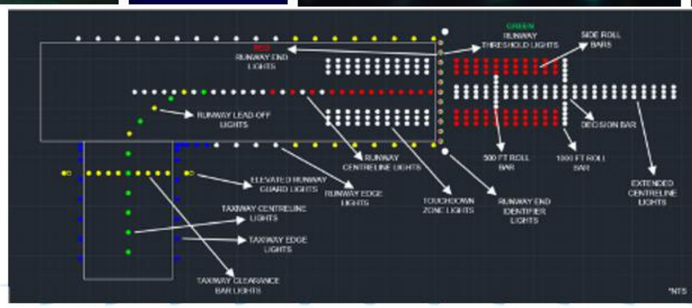
Visual Aids





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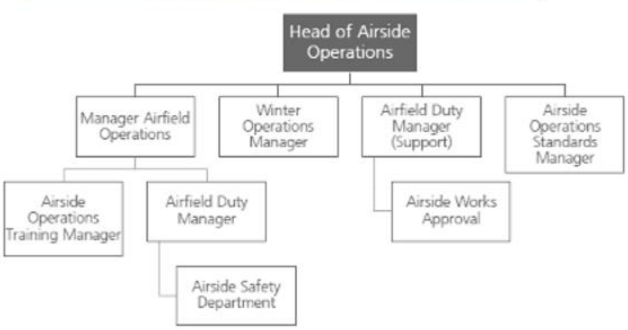
Inspection Procedures



	PCI	PCI	REPRESENTATIVE PAVEMENT SURFACE	REPAIR ALTERNATIVE
ROUTINE MAINTENANCE	86 - 100	90		Pavements with PCIs above 85 will benefit from routine maintenance actions, such as periodic crack sealing, periodic joint resealing, or patching.
PAVEMENT 'RESERVATION	56-85	65		Pavements with a PCI of 56 (65 for PCC pavements) to 85 may require pavement preservation, such as a surface treatment, thin overlay, or PCC joint resealing.
MAJOR HABILITATION	0 - 55	25		Pavement allowed to deteriorate below a PCI of 55 (65 for PCC) will require costly reconstruction to restore it to operational condition.

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Scenarios Description

Users: operators checks as part of the airport ASD, APOC, (ATC).

Technologies: Cloud UTM Platform, FINoT platform, Visual Analytics, GGCS, 5D api toolbox, one multicopter drone, DGPS, dedicated communication channel for C3 if deemed appropriate

Location: Heathrow airport various areas, daytime and nighttime

Scenario 1: level 2 routine inspection
- **Mission 1:** 1/32 area inspection of taxiway and stand surface (daylight) – as automatic as possible assessment
- **Mission 2:** 1/32 area inspection of taxiway and stand lighting (nighttime) – totally automatic

Scenario 2: Runway foreign object detection at the request of ATC
Scenario 3: Terminal 4 rooftop inspection, engineering works
Scenario 4: Perimeter control (northern fence surveillance)

All scenarios are performed in VLOS, areas are closed to traffic during inspections.

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Trial D: Airport and Waterairport

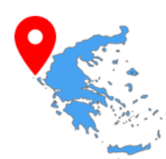
Waterdrome use cases objectives

a. The waterdrome safety supervisor needs to deal with 5 cases every day, and some of them before every flight: inspection of the entire facility, inspection of mooring and docking points, inspection of lighting and windsock, inspection of signs and floor marking, inspection of waterways

b. Drone based operation can reduce the workload and duration of such operations, provided they can be safely operated in close vicinity of a port and an airport, with the benefit of the 5D technologies

Scientific & Technical Objectives:

- STO3: to conduct waterway visual inspection using UAS looking for obstacles and the wave conditions before alighting clearance by Air Traffic.
- STO6: to build an API toolbox that will enable the easy integration of future applications on UTM Systems through the 5D -AeroSafe platform.
- STO7: to pave the way for the airborne means of surveillance and control to serve Remote Tower Operations



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5D-AeroSafe Use Cases in Pictures

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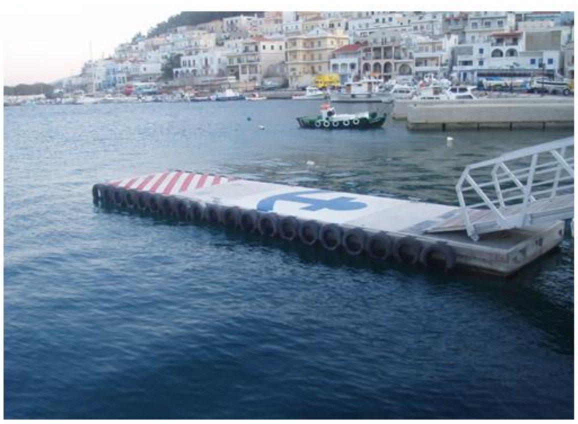
5D-AeroSafe Use Cases in Pictures



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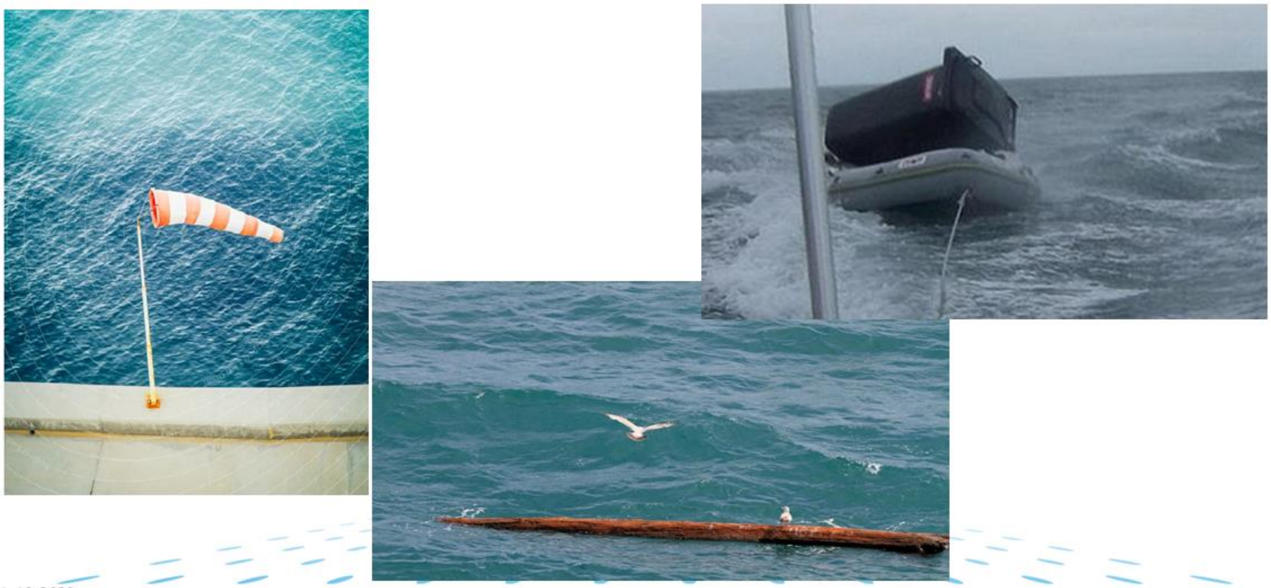
5D-AeroSafe Use Cases in Pictures



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Work Scenarios, Users Needs

- Inspection of the **entire facility**, starting from the main passenger service building, access roads to the facility, the fenced passenger traffic area, sheds.

- Inspections of **mooring and docking points**, either on docks or floating platforms or jetty, prior seaplane approaches.

- Inspection of the **optical reconnaissance light** of aviation activity and the windsock.

- Inspection of **all signs and floor markings** to ensure that are well visible, clear and without technical problems.

- Inspection of **waterways** (runway on the water surface).

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5DAEROSAFE

Scenarios Description

Users: WSS, drone mission operator, drone safety operator (emergency services, coast guard, port authorities)

Technologies: Cloud UTM Platform, FINoT platform, Visual Analytics, GGCS, 5D api toolbox, one multicopter drone, DGPS, dedicated communication channel for C3 if deemed appropriate

Location: Corfu waterdrome, within the LGKR CTR, daytime

Scenario 1: waterdrome visual inspection

- **Mission 1:** general panoramic inspection, docks and mooring points
- **Mission 2:** repetitive routine inspection, each morning, including the waterway before each flight,

All scenarios are performed in VLOS and BVLOS areas are closed to traffic during inspections.

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Use Case analysis

- Scenarios are VLOS & BVLOS, daytime and nighttime
- Probably open or specific category
- STO coverage

Table 1

	Tria A					
STO1 GNSS transceiver						
STO2 Navaids PAPI						
STO3 obstacles, FOD, birds, lighting, wave conditions		TODO				
STO4 RNAV procedures						
STO5 GNSS jamming						
STO6 UTM API						
STO7 remote tower contingency						

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Next Steps

WP2:

- Consolidate user requirements
- Prepare a system concept of operations
- Check against the regulatory framework
- Consolidate use case, turn them in UML and runnable simulations

WP6:

- architecture
- trials (M10 M24 MTODO)
- real flights will require authorization: SORA (CONOPS)

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